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Job Completion Report

Project F-59-R-7

F-59-R-8

EVALUATION OF ANGLING REGULATIONS IN MANAGEMENT OF CUTTHROAT TROUT

Period Covered: March 1, 1975 to February 28, 1977
(also summarizes 8 years of study)

by

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JOB COMPLETION REPORT RESEARCH PROJECT SEGMENT

State of Idaho Name: EVALUATION OF ANGLING REGULATIONS IN MANAGEMENT OF CUTTHROAT TROUT

Project No. F-59-R-7- 8

Job No. 1 Title: Same as above

Period Covered: March 1, 1975 to February 28, 1977

(also summarizes 8 years of pertinent data)

ABSTRACT:

We report here the effects of special angling regulations on native cutthroat trout (Salmo clarki Richardson) populations and fisheries in three northern Idaho streams. The Kelly Creek drainage was managed with catch-and-release regulations starting in 1970. Trophy-fish regulations (13-inch minimum size - 3 fish bag limit) were initiated on the upper St. Joe River drainage in 1971. The drainage of the North Fork of the Clearwater River upstream from Kelly Forks had standard regulations.

Catch-and-release and trophy-fish regulations improved the cutthroat trout population structures and fisheries in Kelly Creek and the upper St. Joe River. Standard regulations did not change the cutthroat population structure or fishery in the North Fork, even when the bag limit was reduced from 15 fish to 3 fish.

Annual mortality rates for age III and older cutthroat trout declined in Kelly Creek and the upper St. Joe River as a result of special angling regulations. In Kelly Creek, we estimated the annual mortality rate at 0.63 in 1969 and 0.82 in 1970, but less than 0.50 in 1974 and 1975. In the upper St. Joe River, we estimated the annual mortality rate at 0.62 in 1969 and 0.71 in 1970, prior to initiation of special regulations, compared to 0.47 in 1974 and 0.56 in 1975.

Cutthroat trout of all sizes increased in abundance in the streams with special regulations. We counted 13 times more cutthroat per snorkeling transect on Kelly Creek in 1975 than in 1970, and 3 to 5 times more cutthroat in the upper St. Joe River transects in 1975 than in 1970. The increased abundance of small (<150 mm) cutthroat in Kelly Creek and the St. Joe River was evidence of increased recruitment to the population and fisheries. Increased numbers of large (>250 mm) cutthroat was evidence that many small fish caught and released by anglers survived and became available to anglers at a larger size. Spawner-sized cutthroat increased 10-fold or more in the St. Joe River and Kelly Creek. On the North Fork, cutthroat trout abundance retained virtually unchanged since 1970.

The number of hours fished declined initially as a result of special regulations. Angler effort increased to pre-special regulation levels with tr0phy-fish angling regulations, but remained at about 20% of former levels

with catch-and-release regulations. Angler catch rates on Kelly Creek increased from 0.4 cutthroat/hour in 1970 to 1.3 cutthroat/hour in 1975. On the St. Joe River, angler catch rates increased from 0.2 cutthroat/hour in 1968 to about 2.5 cutthroat/hour in 1975. On the North Fork, anglers caught 0.2 cutthroat/hour in 1970 and 1975. Anglers caught 5 times more cutthroat trout in the St. Joe River in 1975 than in 1968, but the angler harvest of cutthroat decreased. On Kelly Creek, angler catch of cutthroat remained about the same, even with decreased angler effort, but harvest of cutthroat was eliminated.

Characteristics of anglers fishing Kelly Creek (angling method, age, sex, and state of residence) and the St. Joe River (angling method and state of residence) changed since special regulations were initiated. For the North Fork, only the proportion of resident anglers changed since 1969. In 1975, more than 90% of the anglers interviewed while fishing Kelly Creek and the St. Joe River favored the special regulations and most anglers thought that fishing was better in 1975 than before special regulations were initiate: On the North Fork, 68% of the anglers interviewed believed that quality of angling on the North Fork had declined since the late 1960's.

In Kelly Creek, cutthroat grew about 55 mm a year during their first two years in the river (4th and 5th years of life), and most male and female cutthroat matured at age VI. Cutthroat trout grew about 60 mm a year during their first three years in the upper St. Joe River (3rd, 4th, and 5th years of life), and most male and female cutthroat matured at ages IV and V, respectively.

Returns of fish tagged and released in the three study streams indicate that cutthroat trout migrated upstream into the upper drainages (study areas) in the spring and early summer, few cutthroat moved during the summer and cutthroat migrated downstream to lower portions of the drainages in the fall. Downstream fall migrations of cutthroat trout probably increased their overwinter survival.

To document the full effect of the catch-and-release and trophy-fish angling regulations on cutthroat trout populations and fisheries, the special regulations should be continued until the cutthroat populations reach maximum abundance. Future management alternatives for the cutthroat trout fisheries in Kelly Creek and the upper St. Joe River and their trade-offs are discussed.

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INTRODUCTION

Stream dwelling populations of native cutthroat trout (Salmo clarki Richardson) in Idaho have declined in recent years. The primary cause of the decline was the increase in fishing pressure and cutthroat harvest wherever roads improved angler access. Changes in the management of the cutthroat populations and their fisheries were necessary to halt the downward trends. Alternative management considerations included: (1) supplemental stocking of cutthroat fry or fingerlings, (2) habitat improvement, and (3) special angling regulations such as catch-and-release and trophy-fish programs to reduce mortality. This project was undertaken during 1974 and 1975 to assess the changes in stream dwelling cutthroat trout populations caused by catch-and-release and trophy-fish regulations.

Kelly Creek, a tributary to the North Fork of the Clearwater River, was selected as an experimental catch-and-release fishing area in 1970. In a 1969 statewide survey, Gordon et al. (1970) found that half of the anglers thought native trout populations should be maintained, 60% thought catch-and-release regulations deserved testing, and 49% agreed to try fishing with catch-and-release regulations. To assess public preferences on the St. Joe River, we contacted anglers while they were fishing the river and held public meetings in communities adjacent to the river during 1970. During these contacts we described the status of the stocks, the alternatives as we saw them, and the trade-offs associated with each alternative. A surprisingly large percentage (88%) of the anglers preferred to save the cutthroat trout even though it meant restricted harvest rather than to continue the present management program of releasing hatchery-reared rainbow trout (Salmo gairdneri Richardson) to replace the native cutthroat (Bjornn 1975). In 1971,

trophy-fish angling regulations were initiated on the upper St. Joe River to protect and perpetuate the native cutthroat trout population.

Personnel from the Idaho Cooperative Fishery Research Unit conducted studies of the study streams starting in 1969. Ball (1971) studied Kelly Creek and the North Fork of the Clearwater River in 1969 and 1970. Rankel (1971) studied the upper St. Joe River in 1969 and 1970. The present project was undertaken in 1974 and 1975 to continue the assessment of the biological changes in stream dwelling cutthroat trout populations caused by catch-and-release and trophy-fish angling regulations, and to compare the fish populations and fisheries managed with the two types of angling regulations.

STUDY STREAMS

We studied the fish and fisheries of three Northern Idaho streams: Kelly Creek, the upper St. Joe River, and the upper North Fork of the Clearwater River (Figs. 1 and 2).

Prior to 1970 all three streams had the standard statewide regulation of a 15 fish bag limit with no size restriction and were stocked with hatchery-reared rainbow trout (Table 1). To reduce angler-caused mortality of the cutthroat trout, the Kelly Creek drainage was established as an experimental catch-and-release fishing area in 1970. To allow cutthroat to spawn once before being harvested by anglers, a trophy-fish regulation (3 fish bag -13 inch minimum size limit) was initiated on the St. Joe River drainage upstream from Prospector Creek in 1971. The St. Joe River downstream from Prospector Creek served as a control section with standard regulations (10 fish bag - no size limit) and was stocked with rainbow trout. The drainage of the North Fork of the Clearwater River upstream from Kelly Forks had the standard regulations until 1972 when a 3 fish bag - no size limit regulation with no supplemental stocking began.

We studied 22 miles of Kelly Creek, 4 miles of one of Kelly Creek's major tributaries (Cayuse Creek), 23 miles of the upper North Fork of the Clearwater River, and 44 miles of the upper St. Joe River. Since type of access to the streams (Figs. 1 and 2) affects the amount of angling and the cutthroat harvest, we divided each study stream into sections based upon the presence of roads or trails along the streams.

All three streams originate in the Bitterroot Mountains near the Idaho-Montana border and flow through rugged terrain. In the study area, stream

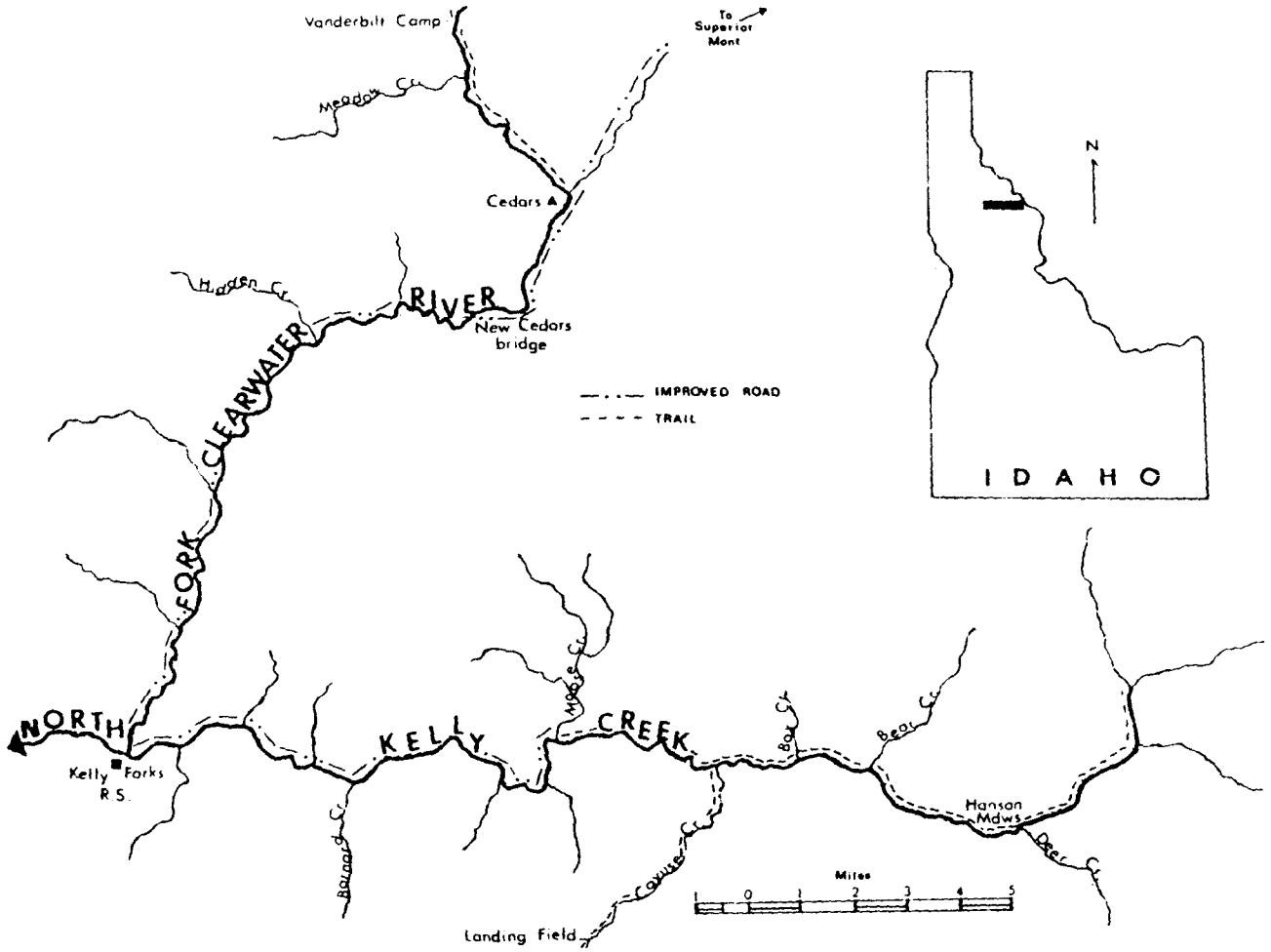


Figure 1. Location of the Kelly Creek-North Fork study areas showing type of access to the streams. The Kelly Creek drainage is under a special (catch-and-release) regulation and the North Fork of the Clearwater River drainage has a standard (3 fish bag, no size limit) regulation.

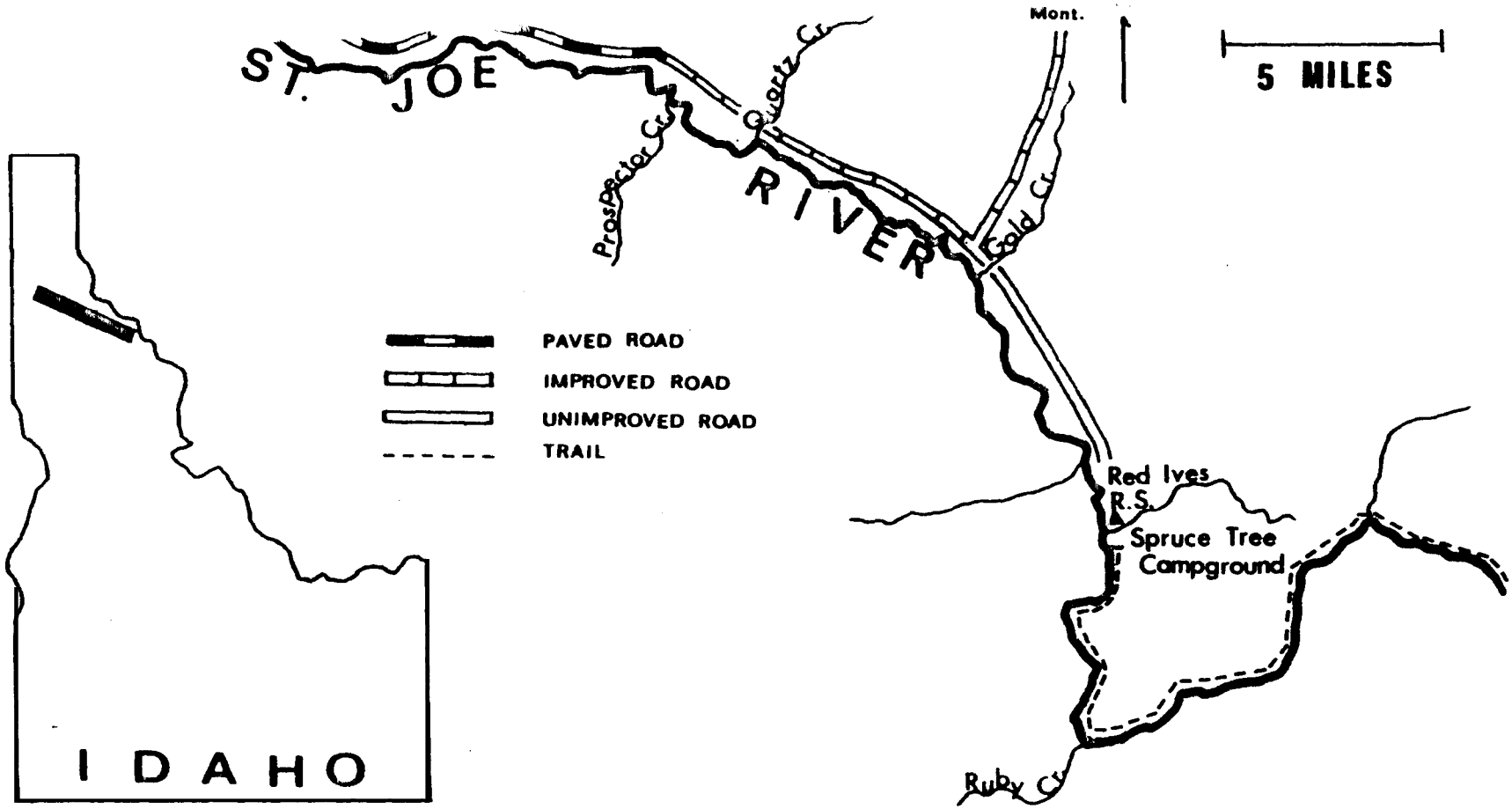


Figure 2. Location of the upper St. Joe River study area showing type of access to the stream. The St. Joe River drainage below Prospector Creek is under a standard (10 fish bag, no size limit) regulation and is supplementally stocked with hatchery rainbow trout. Above Prospector Creek, a special (trophy-fish, i.e., 3 fish bag, 13" minimum size limit) regulation is in effect.

Table 1. History of angling regulations on the three study streams.

Year	St. Joe River: Avery to Prospector Creek	St. Joe River: Prospector Creek to headwaters	Kelly Creek	North Fork
Prior to 1970	← 15 fish bag - no size limit Stocking with HRB[1] →			
1970	"	"	Catch-and-release No bait fishing No stocking HRB[1]	15 fish bag - no size No stocking HRB[1]
1971	"	Trophy-fish regulation (3 fish bag, 13" minimum size) No bait fishing No stocking HRB[1]	"	"
1972	10 fish bag - no size Stocking with HRB[1]	"	"	3 fish bag - no size No stocking HRB[1]
1973	"	"	Plus: Barbless hooks recommended	"
1974	"	"	Plus: Barbless hooks required	"
1975	"	"	Plus: Single, barbless hooks required	"

[1]HRB = hatchery rainbow trout.

1.9 m/km (36.4 feet/mile) on Kelly Creek, 8.2 m/km (43.5 feet/
North Fork of the Clearwater River, and 7.3 m/lan (38.5 feet/
upper St. Joe River. Near pristine conditions exist in the
the exception of roads which border portions of each stream.
off usually peaks in late May or early June and flows decrease
in summer. Late summer flows were higher than usual in 1975

daily discharge in cubic feet per second (cfs) of the North Clearwater River near Canyon Ranger Station, 44 miles downstream :s, and of the St. Joe River near Calder, 22 miles below 1969 to 1975 (Source: U.S.G.S.).

Mean daily discharge by year						
969	1970	1971	1972	1973	1974	1975
,270	11,260	17,580	19,600	6,580	13,060	10,590
967	1,103	1,299	1,214	748	1,285	1,534
,920	9,012	14,000	14,310	4,210	10,320	8,980
489	568	744	767	471	818	841

simmer water temperatures ranged from 4° C to 200 C in Kelly
2r St. Joe River (Fig. 3). The North Fork generally aver-
in August than Kelly Creek. All three streams are
infertile

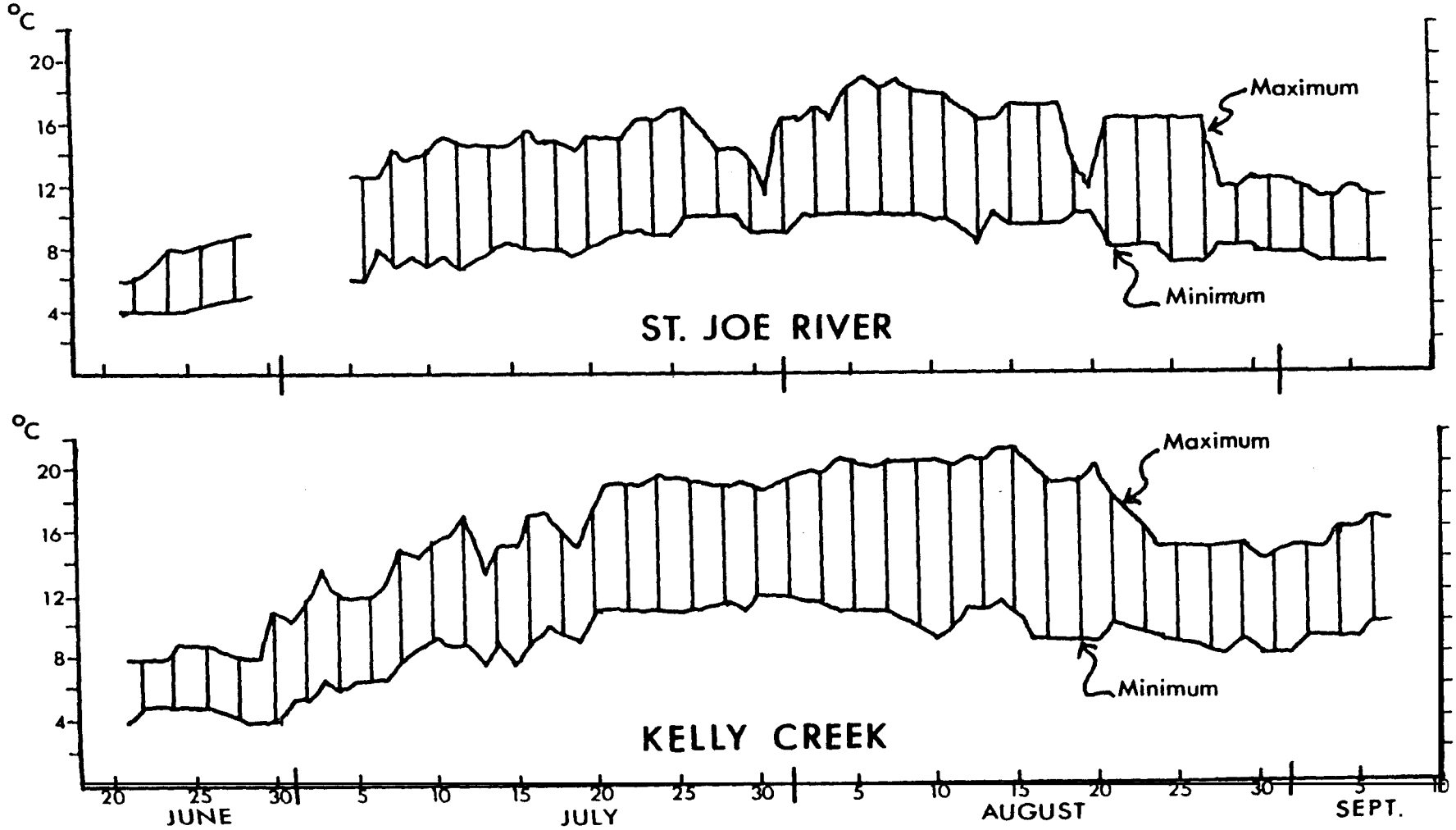


Figure 3. Water temperature profiles of the upper St. Joe River and Kelly Creek, June 21 to September 8, 1975. Maximum-minimum thermometers were located in the St. Joe River one mile below Spruce Tree [illegible] Kelly Creek above the mouth of Moose Creek.

METHODS

Species Composition and Abundance

We assessed species composition and abundance of indigenous fish populations using snorkeling counts of fish in established transects. Within each section of each stream we located and marked longitudinal trend count (transects) varying from 46 meters to 185 meters (50 yards to 200 in length at sites which we considered good cutthroat habitat (Table 3 We took photographs of each transect and recorded the transect location description to facilitate location and counting of the same transects ir. Using a wetsuit and snorkel, we floated down all transects and :ed all of the fish by species and separated cutthroat and rainbow to size classes. On Kelly Creek and North Fork from 1969 to 1973, different divers made consecutive passes about 5 minutes apart on the the transect nearest the road and the counts were averaged. In 1974 on Kelly Creek and North Fork, and in all years on the St. Joe River, floated down both sides of each transect if necessary and counted to the middle of the stream. By remaining as motionless as possible while floating numerated all of the fish in each transect without alarming them. .de (1962), Northcote and Wilkie (1963), Reed (1967), and Graham and

(in preparation) substantiated the validity of snorkeling for assess-

abundance in clear streams.

We endeavored to count fish in the transects on cloudless days between 1630 when visibility was maximum. From 1969 to 1973, the lower 20 on Kelly Creek and the North Fork were counted once every two weeks in July and August. In 1974 and 1975, we counted fish in these transects

Table 3. Number of snorkeling transects per study section in the Kelly Creek-North Fork and upper St. Joe River study areas.

Study section	Number of transects
Kelly Creek	
Kelly Forks to Moose Creek	20
Moose Creek to Cayuse Creek	6
Cayuse Creek	6
Box Creek to Deer Creek	6
North Fork	
Kelly Forks to Hidden Creek	20
New Cedars Bridge to Cedars	12
Cedars to Vanderbilt Camp	14
St. Joe River	
Avery to Prospector Creek	7
Prospector Creek to Gold Creek	10
Gold Creek to Spruce Tree Camp	5
Spruce Tree Camp to Ruby Creek	6

on dates comparable to previous years, but only once each month. In 1974 and 1975, we counted the rest of the Kelly Creek and North Fork transects once during August. From 1969 to 1975, all of the St. Joe River transects were counted ore in mid-August. We believe that movement of fish from section to section of each stream was negligible each year.

Size of Fish, Catch Rate, and Movement

Project personnel captured fish by hook-and-line, tagged the cutthroat and rainbow trout with monel-metal mandible tags, recorded the tagging location, measured fork and/or total length, collected scale samples, and released all fish at the capture site to assess size of fish, catch rates, fish movement, and growth. Angler cooperation in the return of information from tagged fish was encouraged by information posters and tag return boxes we placed in the study areas and we talked to as many anglers as possible. On Kelly Creek and the North Fork we standardized the angling effort of project personnel by fishing one-half hour with a nickel "Mepps" spinner (size 0) and one-half hour with a "Renegade" fly (size 10 or 12) in each transect. In 1975, we also counted all of the Kelly Creek transects in September and October to assess fish movement during the fall.

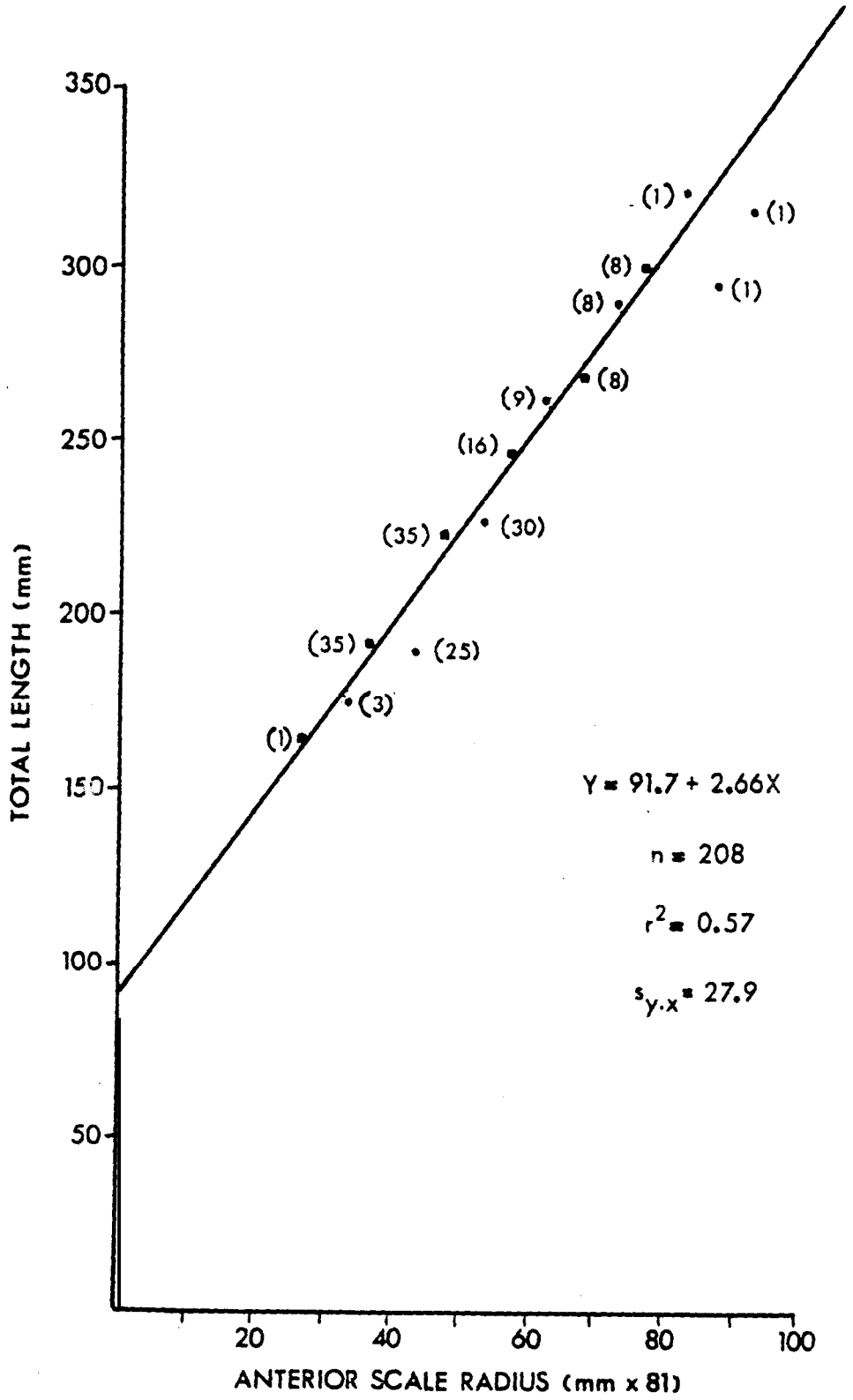
Age-Growth of Cutthroat Trout

To determine the age and growth of the cutthroat trout in Kelly Creek and the upper St. Joe River in 1975, we collected scales from the area between the lateral line and the adipose fin, where scales first form (Brown and Bailey 1952, Averett 1963, Cooper 1970). I mounted the scales on 0.05 cm x 2.5 cm x 7.6 cm cellulose acetate slides using a heat press method. I pressed the scales at a pressure of 25,000 pounds per square inch for 75

seconds at 150^0 F. Referring to the guidelines in Lagler (1956), Ricker (1968), and with occasional consultation, I aged several scales of each fish at a magnification of 81% using an Eberbach scale projector. I measured the anterior scale radius and the distance to each annulus to the nearest millimeter.

I utilized a computer program designed to determine the body-scale relationship (using the measurements of individual fish) and back-calculate lengths at each annulus. A first degree polynomial (first, second, and third degree polynomials were tested) best described the body-scale relationship of cutthroat trout in the upper St. Joe River ($r^2 = 0.79$) and Kelly Creek ($r^2 = 0.57$) in 1975 (Figs. 4 and 5). A second degree polynomial fit the body-scale data best for cutthroat trout collected from the upper St. Joe River ($r^2 = 0.99$) in 1969-1970 (Rankel 1971), probably because age 0 and 1 cutthroat collected in the tributaries were included in the sample. Ball (1971) fit a first degree polynomial ($r^2 = 0.97$) to cutthroat collected from Kelly Creek and the North Fork of the Clearwater River in 1969 and 1970.

Rankel and Ball grouped the anterior scale radii into 4 and 5 mm divsions, respectively, before calculating the best body-scale fit. When I grouped the 1975 body-scale data into 5 mm anterior scale radius classes and fitted a linear regression of mean fish length on mean anterior scale radius for each group, I calculated body-scale regression equations with r2 values of 0.97 and 0.95 for the upper St. Joe River and Kelly Creek, respectively Grouping the anterior scale radii into 5 mm divisions reduced the number of observations, lowered the variability of the data, and consequently increased the r^2 values. In the back-calculation of lengths to each annulus, I used the regression line based on the individual observations (fit by compu*ter*)



Body-scale relationship of cutthroat trout collected from Kelly '75. Regression equation from ungrouped data.

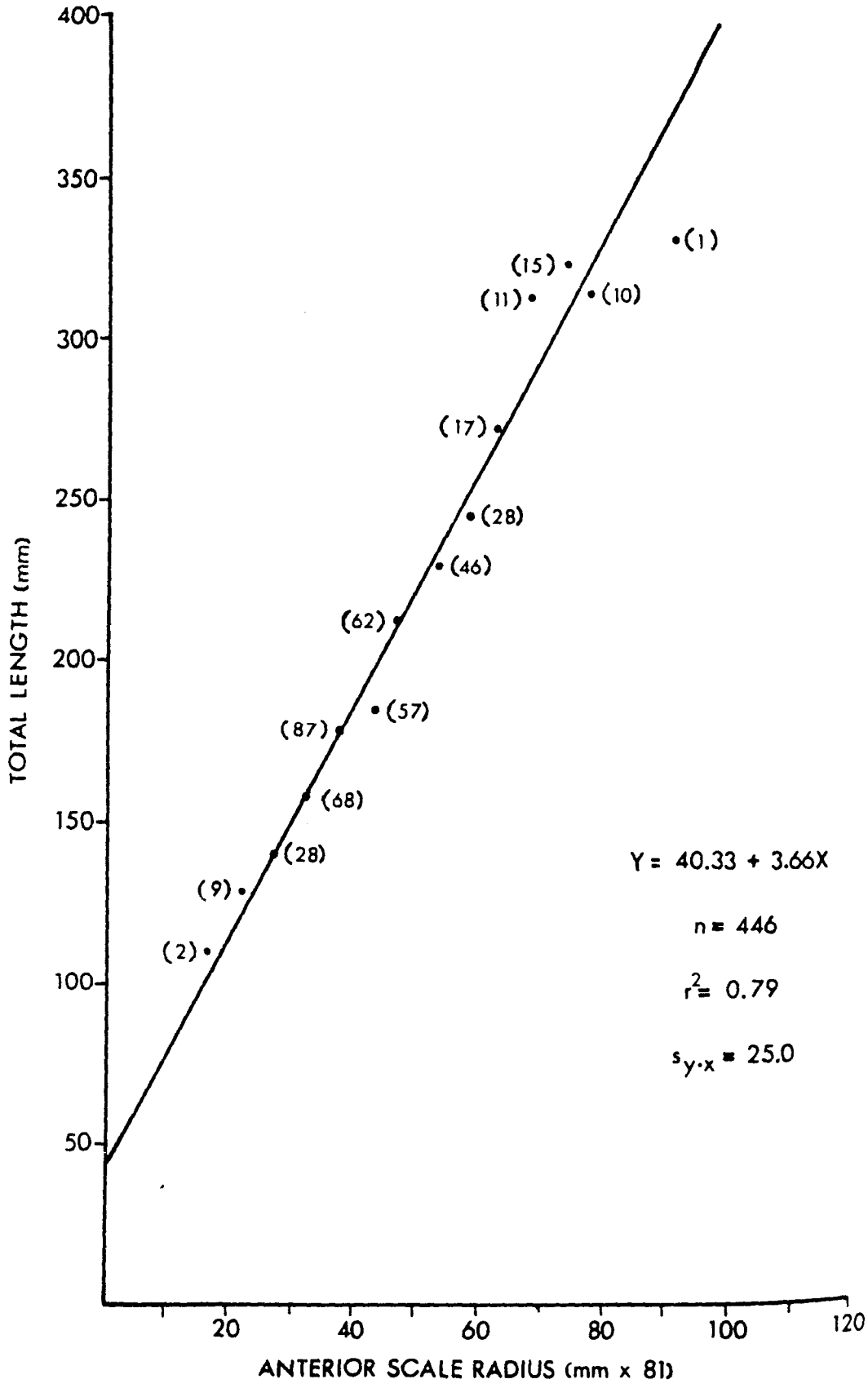


Figure 5. Body-scale relationship of cutthroat trout collected from the upper St. Joe River, 1975. Regression equation from ungrouped data.

even though the r2 values were lower. I believe these equations more accurately reflect the variability of the scale measurements of individual cutthroat trout and, hence, the body-scale relationship.

Most cutthroat trout form scales at lengths of about 40 to 45 mm (Laasko and Cope 1956, Averett 1963, Cooper 1970, Rankel 1971) so the y= intercept of 91.7 for Kelly Creek in 1975 seems unreasonably high if the y= intercept is interpreted as the size of fish at the time of scale formation. I placed a 95% confidence interval on the y-intercept to see if values near 45 mm were included in the confidence interval. The resultant 95% confidence interval was 91.7 ± 16.5 mm.

The value of a in the linear body-scale regression equation Y = a + bX would approximate the length of fish at the time of scale formation only if the body-scale relationship was linear throughout life and an adequate sample of all sizes of fish was used. Hagenbuck (1970) calculated body-scale regression equations for cutthroat trout in the Snake River, Wyoming, and computed y=intercepts ranging from 89 to 121 mm. Hagenbuck concluded the high y= intercepts were probably due to the absence of age 0 fish in the calculations. We collected no age 0 or age I cutthroat from Kelly Creek in 1975, and only 26 age II cutthroat. To determine the effect of the scarcity of ages 0-II cutthroat, I added the scale measurements of 19 age II cutthroat caught from tributaries of Kelly Creek in 1969 and 1970 to the 1975 body-scale data, and calculated a new regression line. The addition of only 19 age II cutthroat changed the regression equation to Y = 68.0 + 3.08X, lowering the y=intercept from 91.7 to 68.0. The back-calculated lengths at annuli I, II, and III were smaller using Y = 68.0 + 3.08X while the lengths at annuli IV, V, and VI were not appreciably altered. When I removed these same 19 age II cutthroat from

the 1969-1970 body-scale data and recalculated the body-scale relationship, the y-intercept was raised from 38.2 to 57.0 and the back-calculated lengths at annuli I, II, and III increased while the back-calculated lengths at annuli IV and V were not appreciably altered.

This procedure demonstrated the importance of including fish from all size classes when calculating a body-scale relationship. Because of the absence of small fish in the 1975 age-growth data of Kelly Creek, the back-calculated lengths at annuli I, II, and III contained a positive bias. The regression equation in Fig. 4 reliably describes the body-scale relationship of only age IV and older cutthroat. Since I could not obtain accurate back-calculated lengths for ages I, II, and III using the body-scale relationship from 1975 data, I used the regression equation Ball (1971) calculated from 1969-1970 data.

To determine changes in growth of cutthroat trout in Kelly Creek and the upper St. Joe River, for each cutthroat collected in 1969-1970 and 1975 I (1) measured the distance from the scale focus to each annulus, (2) measured the distance between consecutive annuli to determine increments of growth, and (3) performed t-tests on the scale measurements to each annulus and on the increments of growth. By comparing actual scale measurements instead of back-calculated lengths to each annulus or back-calculated increments of growth, I minimized differences in the 1969-1970 and 1975 body-scale regression equations. To determine changes in growth (in millimeters), I applied the scale measurements to calculated body-scale regression equations of cutthroat trout. For Kelly Creek, I applied the body-scale regression equation $Y = 38.18 + 3.58X$, calculated by Ball (1971), to the 1969-1970 and 1975 data. For the St. Joe River, I applied the body-scale regression equation in Fig. 5 to the 1969-1970 and 1975 data.

Maturity

Using Nikolsky's (1963) classification of maturity as a guide, we classified cutthroat as mature (would spawn the following spring) or immature. We inspected the size and state of the gonads of 115 cutthroat trout and 20 rainbow trout collected from Kelly Creek, and of 24 cutthroat trout collected from the upper St. Joe River during September and October, 1975. On the St. Joe River, we also included in our maturity classification 181 cutthroat collected and examined in 1969 and 1970 by Rankel (1971).

Age Structure and Mortality of Cutthroat Populations

To utilize the large length-frequency samples from different sections of Kelly Creek and the upper St. Joe River in different years, I converted length-frequencies of the project personnel catch to their respective age-frequencies. I used age-growth data to compute the mean length in summer of each age-class. Because distribution of lengths within age-classes overlapped with those of adjacent age-classes, I calculated the standard deviation around each mean, and used only those lengths in mutually exclusive standard deviations, and in non-coincident parts of overlapping standard deviations, in the conversion process (Tables 4 and 5). An example of this technique is illustrated in Figure 4 of Rankel {1971). From the computed age-frequencies, I calculated weighted instantaneous mortality rates (Z) according to Rounsefell and Everhardt (1953), and found corresponding annual mortality rates (A) and annual survival rates (S) in Ricker's (1975) table of exponential functions and derivatives (Table 6).

Before I could justifiably compare age distributions and mortality rates of cutthroat trout populations between years, between sections of the same river, or between rivers, I had to be reasonably certain that the scales

Table 4. Mean total length at capture of cutthroat trout of ages II to VI, standard deviations of the mean length of each age group, and conversion limits used to convert length-frequencies to age-frequencies for cutthroat trout collected in Kelly Creek from 1969 to 1975. Conversion limits represent cutthroat trout of ages and lengths in mutually exclusive standard deviations and non-coincident parts of overlapping standard deviations.

Years	Age class	Sample size	Mean TL[3] at capture (mm)	Standard deviation	Conversion limits (TL in imn)
1969-1970[1]	II	5	176	32.4	144-208
	III	94	201	19.8	181-218
	IV	28	254	35.5	222-289
	V	3	302	7.6	294-310+
	VI	0	--	--	--
1971-1975[2]	II	26	182	19.1	163-184
	TII	96	211	27.1	202-223
	IV	64	248	25.6	238-264
	V	13	292	28.7	274-312
	VI	8	328	15.9	322-344+

(Calculated from 1969 and 1970 age-growth data.
[2]Calculated from 1975 age-growth data and applied to length-frequencies from 1971 through 1975.
[3]TL = 1.04 FL for 799 cutthroat collected in 1974-1975.

Table 5. Mean total length at capture of cutthroat trout of ages I to VI, standard deviations of the mean length of each age group, and conversion limits used to convert length-frequencies to age-frequencies for cutthroat trout collected in the upper St. Joe River from 1969-1970 and 1974-1975. Conversion limits represent cutthroat trout of ages and lengths in mutually standard deviations and non-coincident parts of overlapping standard deviations.

Years	Age class	Sample size	Mean TL at capture (mm)	Standard deviation	Conversion limits (TL in mm)
1969-1970[1]	I	53	78	13.9	64-92
	II	27	119	20.1	99-139
	III	128	187	26.4	160-197
	IV	125	226	27.9	214-250
	V	32	285	34.2	255-288
	VI	8	353	64.2	319-417
1974-1975[2]	II	80	147	18.2	129-159
	III	251	189	28.5	166-217
	IV	82	260	33.6	226-288
	V	31	311	21.8	294-333
	VI	2	370	13.4	357-382+

From Rankel (1971).
Calculated from 1975 age-growth data and applied to length-frequencies from 1974 and 1975.

Table 6. Calculation of the instantaneous mortality rate (Z), annual survival rate (S), and annual mortality rate (A) from an age-frequency distribution. The example is for cutthroat trout caught from the upper St. Joe River in 1974.

A	B	C	D	E			
Age (y)	Age frequency (f)	Log of age frequency (log f)	Log of f(y)[1] minus log of f(y-l)	Column D times (square root of smallest f)[2]	(Z)[3]	(S)[4]	(A)[4]
I	0						
II	41						
III	219	2.3404					
IV	175	2.2430	0.0974	1.288	2.967		
V	91	1.9590	0.2840	2.709	6.239		
VI	7	0.8451	1.1139	2.947	6.787		
					0.63	0.53	0.47

[1]Negative sign dropped after subtraction.
[2]Weighting factor.
[3]lndividual weighted (Z)'s = 2.3026 times column E. Mean weighted (Z) = sum of individual weighted (Z)’s divided by sum of the weighting factors.
[4]From Ricker's (1975) table of exponential functions

were read and measured the same in 1969-1970 and 1975, and that the cutthroat had similar growth rates. I read 75 of the scales collected in 1969-1970 and computed the mean distance to each annulus. Results of t-tests at various probability levels on the scale measurements to each annulus led me to believe that the scales were aged and measured the same in 1969-1970 versus 1975 (Table 7), and that cutthroat populations had similar growth rates (1) in Kelly Creek in 1969-1970 versus 1975 (Table 8), (2) in the upper St. Joe River in 1969-1970 versus 1975 (Table 9), (3) in 1975 in the section of Kelly Creek with access by road versus the section with access by trail (Table 10), (4) in 1975 in the section of the upper St. Joe River with access by road versus the section with access by trail (Table 11), and (5) in 1975 in Kelly Creek versus the upper St. Joe River (Table 12). Most cutthroat were recruited to the St. Joe River and Kelly Creek from the tributaries at age III.

Angler Use. Harvest, and Opinions

Creel census methods used in the Kelly Creek-North Fork study area from 1969 through 1973 were described by Ball (1971) and Hogander et al. (1974). In 1974, we contacted anglers in the course of other project activeties, but did not make special efforts to conduct an in-depth creel census on the three streams. In 1975, to minimize the variability of estimates of angler effort, angler catch, and angler catch rates, we conducted a stratified random angler count and creel census on the three study streams in the sections with access by road. A similar creel census was conducted on the upper St. Joe River in 1968 and from 1971 to 1973. We divided the census season, June 19 to September 10, into four 3-week intervals. To compensate for the decrease in number of daylight (fishing) hours, each day had four 4-hour periods in July and four 3 1/2-hour periods in August and September. There

Table 7. The mean scale radius measurements (in mm at 81X magnification at each annulus of St. Joe River cutthroat trout as read by Johnson in 1975 versus those read by Rankel in 1969-1970, difference between means, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
Johnson (a)	13.24	21.67	35.32	50.92	67.09
Rankel (b)	12.65	21.64	35.86	51.97	66.17
Xa - Xb	+0.39	+0.03	-0.54	-1.05	+0.92
Sd	0.96	0.75	1.03	1.94	3.29
df	32	136	128	76	20
Computed t	0.62	0.04	0.52	0.54	0.28
Probability of larger t	0.7-0.5	>0.9	0.7-0.5	0.7-0.5	0.9-0.7

Table 8. The mean scale radius measurements (in mm at 81X magnification) at each annulus of Kelly Creek cutthroat trout collected in 1975 versus 1969-1970, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
1975 (a)	7.82	17.66	32.19	48.68	59.55
1969-1970 (b)	8.59	18.88	31.18	44.58	59.00
Calculated total length					
1975	66.2	101.4	153.4	212.4	251.4
1969-1970	68.9	105.8	149.8	197.8	249.4
Xa - Xb	-0.77	-1.22	+1.01	+4.10	+0.55
Sd	0.20	0.43	0.71	1.66	3.93
df	250	336	305	114	21
Computed t	3.80	2.87	1.42	2.47	0.14
Probability of larger t	<0.001	0.01-0.001	0.2-0.1	0.02-0.01	0.9-0.7

Table 9. The mean scale radius measurements (in mm at 81X magnification) at each annulus of St. Joe River cutthroat trout collected in 1975 versus 1969-1970, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
1975 (a)	7.39	17,88	34.25	49.56	69,25
1969-1970 (b)	12.49	20.95	35.15	50.20	73.53
Calculated total length					
1975	67.4	105.8	165.7	221.7	293.8
1969-1970	86.0	117.0	169.0	224.1	309.4
Xa - Xb	-5.10	-3.07	-0,90	-0.64	-4.28
Sd'	0.16	0.31	0.57	1.18	3.30
df	407	634	553	230	56
Computed t	27.51	9.81	1.58	0.54	1.30
Probability of larger t	<0.001	<0.001	0.2-0.1	0.7-0.5	0.2-0.1

Table 10. The mean scale radius measurements (in mm at 81X magnification) at each annulus of Kelly Creek cutthroat trout collected in 1975 in the section of river with access by road versus the section of river with access by trail, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
Road (a)	7.84	17.66	32.19	48.68	59.55
Trail (b)	7.56	17.02	30.89	46.55	59.91
Xa - Xb	+0.28	+0.64	+1.30	+2.13	-0.36
Sd	0.19	0.50	0.89	1.50	2.25
df	207	295	255	125	40
Computed t	1.50	1.27	1.46	1.42	0.16
Probability of larger t	0.2-0.1	0.3-0.2	0.2-0.1	0.2-0.1	0.9-0.7

Table 11. The mean scale radius measurements (in mm at 81X magnification) at each annulus of St. Joe River cutthroat trout collected in 1975 in the section of river with access by road versus the section of river with access by trail, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
Road (a)	7.40	17.64	33.33	48.62	66.53
Trail (b)	7.35	17.22	32.77	50.75	68.57
Xa - Xb	+0.05	+0.42	+0.56	-2.13	-2.04
Sd	0.10	0.36	0.62	1.33	2.99
df	351	444	363	107	9
Computed t	0.50	1.17	0.90	1.60	0.6E
Probability of larger t	0.7-0.5	0.3-0.2	0.4-0.3	0.2-0.1	0.7-0.

Table 12. The mean scale radius measurements (in mm at 81X magnification) at each annulus of cutthroat trout collected in 1975 from Kelly Creek versus the upper St. Joe River, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
Kelly Creek (a)	7.84	17.66	32.19	48.47	62.95
St. Joe River (b)	7.39	17.88	33.10	49.56	67.45
Xa - Xb	+0.45	+0.21	-0.91	-1.09	-4.50
Sd	0.10	0.29	0.56	1.04	2.26
df	493	652	545	190	49
Computed t	4.53	0.75	1.63	1.04	0.99
Probability of larger t	<0.001	0.5-0.4	0.2-0.1	0.3-0.2	0.4-0.3

were 2 counts/period/interval on weekend days and 3 counts/period/interval on weekdays. We made two additional counts on each holiday. All counts were randomly selected using a random numbers table.

In the Kelly Creek-North Fork study area, we counted anglers as we drove from Moose Creek down Kelly Creek to Kelly Forks and then up the North Fork of the Clearwater River to Hidden Creek or on a reverse route (Fig. 1). On the St. Joe River we counted anglers as we drove from Spruce Tree Camp to Avery and vice versa (Fig. 2). As we made counts, we interviewed anglers to assess catch per unit effort, method of fishing, fish size preference, catch composition, length of angling day, anglers in party, angler opinions. residence, sex, and estimated age of anglers. A single count took from 2 to 3 hours to complete.

Estimates of angler effort and catch were computed with the following formulas:

(1) Estimated hours fished per interval by type of day (weekdays or weekend days) = $\frac{DH}{X_{AC}}$

where:

X_{AC} = mean number of anglers counted for all weekday or weekend day counts during an interval.

D = number of days (weekday or weekend days) per interval.

H = number of daylight (fishing) hours per day during an interval. The number of hours fished per interval was the summation of the estimated hours fished on weekdays and weekend days. Total angling effort for the census season was the summation of the effort in each interval.

(2) Estimated catch for each interval =

{hours fished in the interval) x (catch/hour in the interval).

Total angler catch for the census season was the summation of the catch in each interval.

To provide estimates of angler effort on Kelly Creek in 1975 that would be comparable with those in 1969-1973, we also expanded the number of anglers counted during period 2 counts (0945 to 1215) to estimates of fishing intensity as in Ball (1971).

In 1975 we also conducted, with limited success, a volunteer creel census and angler opinion survey in the sections of the three streams with access by trail. We placed questionnaires and deposit boxes at major trailheads and asked anglers to record creel census and opinion survey information and deposit the questionnaires in the boxes.

RESULTS

Species Composition

Kelly Creek-North Fork

Species observed in the entire Kelly Creek study area in 1975 in decreasing order of abundance were: mountain whitefish, Prosopium williamsoni (Girard); largescale sucker, Catostomus macrocheilus Girard; cutthroat trout, Salmo clarki Richardson; rainbow trout (residual steelhead trout), Salmo gairdneri Richardson; northern squawfish, Ptychocheilus oregonensis (Richard son); redside shiner, Richardsonius balteatus (Richardson); and Dolly Varden. Salvelinus malma (Walbaum). Relative abundance of cutthroat and rainbow trout increased in the upstream sections of Kelly Creek, except for the section from Moose Creek to the mouth of Cayuse Creek in 1975 (Table 13). The increased numbers of suckers and squawfish in that section in 1975 may have displaced some cutthroat and rainbow trout.

Species present in the North Fork study area in 1975 in decreasing order of abundance were: largescale sucker, mountain whitefish, rainbow trout (residual steelhead trout), cutthroat trout, northern squawfish, and Dolly Varden (Table 13). In 1975, cutthroat trout increased and rainbow trout decreased in relative abundance from the lower sections to the upper sections of the North Fork. We counted more suckers and squawfish in all sections of the North Fork in 1975 than in 1974 (Table 13).

We counted squawfish further upstream in Kelly Creek and in the North Fork in 1975 than in 1974. In Kelly Creek, we observed squawfish one mile upstream from Moose Creek in 1974, but as far upstream in Kelly creek at the mouth of Cayuse Creek and 4 miles up Cayuse Creek in 1975. In the North

Table 13, Species composition in numbers (and percentage) of the fish observed in the snorkeling transect counts in each section of Kelly Creek and the North Fork of the Clearwater River in August, 1974 and August, 1975.

	Cutthroat trout	Rainbow trout	Whitefish	Sucker	Squawfish	Shiner	Dolly Varden
KELLY CREEK							
Kelly Forks to Moose Creek							
1974 (N 1803)	177 (9.8)	108 (6.0)	635 (35.2)	592 (32.8)	161 (8.9)	129 (7.2)	1 (0.1)
1975 (N = 2118)	355 (16.8)	173 (8.2)	669 (31.6)	649 (30.6)	170 (8.0)	101 (4.8)	1 (---)
Moose Creek to Cayuse Creek							
1974 (N 720)	129 (17.9)	83 (11.5)	445 (61.8)	18 (2.5)	22 (3.1)	21 (2.9)	2 (0.3)
1975 (N = 495)	46 (9.3)	49 (9.9)	190 (38.4)	166 (33.5)	44 (8.9)	0 (---)	0 (---)
Box Creek to Deer Creek							
1974 (N = 522)	177 (33.9)	137 (26.2)	202 (38.8)	0 (---)	0 (---)	0 (---)	6 (1.1)
1975 (N = 532)	119 (22.4)	123 (23.1)	275 (51.7)	14 (2.6)	0 (---)	0 (---)	1 (0.2)
Cayuse Creek (a tributary)							
1974 (N 316)	121 (38.3)	14 (4.4)	181 (57.3)	0 (---)	0 (---)	0 (---)	0 (---)
1975 (N = 432)	124 (28.7)	63 (14.6)	203 (47.0)	24 (5.6)	17 (3.9)	0 (---)	1 (0.2)
ALL SECTIONS COMBINED							
1974 (N = 3361)	604 (18.0)	342 (10.2)	1463 (43.5)	610 (18.1)	183 (5.4)	150 (4.5)	9 (0.3)
1975 (N = 3577)	644 (18.0)	408 (11.4)	1337 (37.4)	853 (23.8)	231 (6.5)	101 (2.8)	3 (0.1)
NORTH FORK							
Kelly Forks to Hidden Creek							
1974 (N - 638)	21 (3.3)	33 (5.2)	411 (64.5)	154 (24.1)	6 (0.9)	0 (---)	13 (2.0)
1975 (N = 1420)	36 (2.5)	88 (6.2)	491 (34.6)	742 (52.2)	48 (3.4)	0 (---)	15 (1.1)
New Cedars Bridge to Cedars							
1974 (N = 488)	13 (2.7)	22 (4.5)	443 (90.8)	3 (0.6)	0 (---)	0 (---)	7 (1.4)
1975 (N - 1127)	53 (4.7)	23 (2.0)	274 (24.3)	719 (63.8)	43 (3.9)	0 (---)	15 (1.3)
Cedars to Vanderbilt Camp							
1974 (N = 292)	13 (4.5)	23 (7.9)	236 (80.8)	0 (---)	0 (---)	0 (---)	20 (6.8)
1975 (N = 478)	19 (4.0)	1 (0.2)	284 (59.4)	156 (32.6)	1 (0.2)	0 (---)	17 (3.6)
ALL SECTIONS COMBINED							
1974 (N = 1418)	47 (3.3)	78 (5.5)	1090 (76.9)	157 (11.1)	6 (0.4)	0 (---)	40 (2.8)
1975 (N = 3025)	108 (3.6)	112 (3.7)	1049 (34.7)	161 (53.4)	92 (3.0)	0 (---)	47 (1.6)

Fork, we counted squawfish to one mile upstream from Kelly Forks in 1974, but as far as 18 miles upstream from Kelly Forks in 1975.

The species composition of fish in Kelly Creek (Kelly Forks to Moose Creek) and the North Fork of the Clearwater River (Kelly Forks to Hidden Creek) has changed since 1969-1970 (Table 14). Prior to 1970, juvenile steelhead reared in the Kelly Creek and North Fork drainages. By 1972, the numbers of juvenile steelhead in the drainages were reduced by about 72% with the closure of Dworshak Dam on the lower end of the North Fork of the Clearwater River. The abundance of suckers and squawfish increased in the study area, possibly as a result of an increase in suitable spawning and rearing habitat in Dworshak Reservoir. A similar increase in the range of non-game species into the upper drainage occurred after the completion of the Pelton Dam on Oregon's Deschutes River (personal communication from Fred Locke, Oregon Department of Fish and Wildlife, 1976).

St. Joe River

Species observed in the upper St. Joe River study area in 1975 in decreasing order of abundance were: cutthroat trout, mountain whitefish, rainbow trout, northern squawfish, and Dolly Varden. Cutthroat were more abundant in the upstream portions and rainbow in the downstream portions of the St. Joe River (Table 15). No rainbow trout were stocked in the special regulations area, but some moved upstream from Prospector Creek. Northern squawfish appeared in the transects as far upstream as Quartz Creek in 1975•

Speckled dace, Rhinichthys osculus (Girard); longnose dace, Rhinichthys cataractae (Valenciennes); and sculpins, Cottus app. were present in all three study streams but we did not assess their abundance. Kokanee, Oncorhvnchus nerka (Walbaum), an introduced species, appeared in the three study areas in their spawning run in late summer and early fall, 1973-1975.

Table 14. Numbers of fish observed in the snorkeling counts in Kelly Creek (Kelly Forks to Moose Creek) and the North Fork of the Clearwater River (Kelly Forks Lo Hidden Creek) during August, 1969 to 1975.

	Cutthroat trout	Rainbow trout	Whitefish	Sucker	Squawfish	Dolly Varden
KELLY CREEK						
1969	4	340	155	10	0	0
1970	10	240	245	8	0	0
1971	41	160	394	8	0	0
1972	60	91	316	5	0	0
1973	25	31	432	25	0	4
].974	65	48	322	196	49	0
1975	132	89	342	251	77	1
NORTH FORK						
1969	2	140	315	1	0	1
1970	10	105	360	1	0	1
1971	15	93	254	3	0	3
1972	19	39	269	0	0	6
1973	17	12	437	6	0	6
1974	9	15	222	49	6	3
1975	22	43	243	370	32	8

Table 15. Species composition of the fish observed in the snorkeling transect counts in each section of the St. Joe River in August, 1974 and August, 1975.

	Cutthroat trout		Rainbow trout		Whitefish		Squawfish		Dolly	Varden
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Avery to Prospector Creek										
1974 (N = 435)	31	7.1%	131	30.1%	273	62.8%	0	--	0	--
1975 (N = 644)	24	3.7	248	38.5	310	48.2	62	9.6	0	--
Prospector Creek to Spruce Tree Camp										
1974 (N = 808)	397	49.1	48	5.9	360	44.6	0	--	3	0.4
1975 (N = 851)	434	51.0	133	15.6	268	31.6	14	1.6	2	0.2
Spruce Tree Camp to Ruby Creek										
1974 (N = 521)	353	67.7	0	--	165	31.7	0	--	3	0.6
1975 (N = 541)	444	82.1	0	--	93	17.2	0	--	4	0.7
ALL SECTIONS COMBINED										
1974 (N = 1764)	781	44.3	179	10.2	798	45.2	0	--	6	0.3
1975 (N = 2036)	902	44.3	381	18.7	671	33.0	76	3.7	6	0.3

Abundance of Trout Populations

Kelly Creek-North Fork

The cutthroat trout population in Kelly Creek increased in abundance since initiation of catch-and-release regulations. Abundance of cutthroat trout in the North Fork of the Clearwater River has not increased with standard angling regulations (Fig. 6).

Cutthroat trout abundance increased in Kelly Creek and the North Fork from 1969 to 1972. Increases in abundance of cutthroat were the result of (1) reduced angling starting in 1970 in both the North Fork and Kelly Creek, (2) fish saved by catch-and-release regulations on Kelly Creek, and (3) the reduction in juvenile steelhead abundance in the streams (Fig. 6). From 1972 to 1975, cutthroat abundance continued to increase in Kelly Creek, but declined slightly in the North Fork (Fig. 6). Catch-and-release regulations effectively protected the cutthroat population in Kelly Creek, but more anglers fished the North Fork after 1972 and the standard regulations (3 fish bag - no size limit) did not prevent the decline in abundance of cutthroat in the North Fork.

In Kelly Creek, we counted more cutthroat and rainbow trout as we moved upstream in 1974 and 1975 (Figs. 7 and 8). We counted nearly twice as many cutthroat per transect in Kelly Creek from Box Creek to Deer Creek and in Cayuse Creek than in transects between Kelly Forks and Moose Creek.

We counted more juvenile cutthroat per transect in the uppermost roadless section (Hanson Meadows to Deer Creek) than in any other section (Figs. 7 and 8). We noted a few trout fry (not identified to species) in Kelly Creek from Box Creek to Deer Creek, but none were observed downstream from

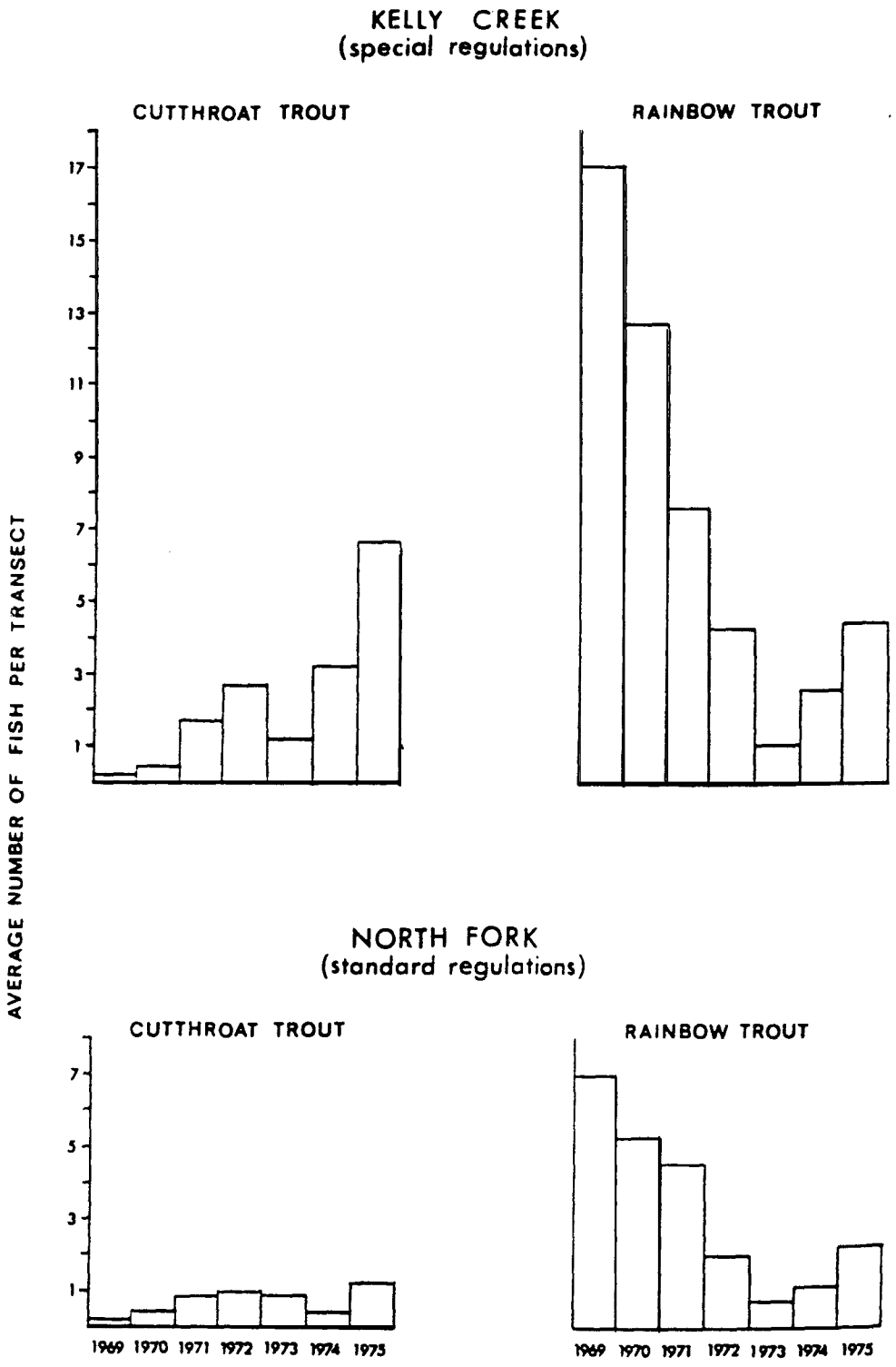
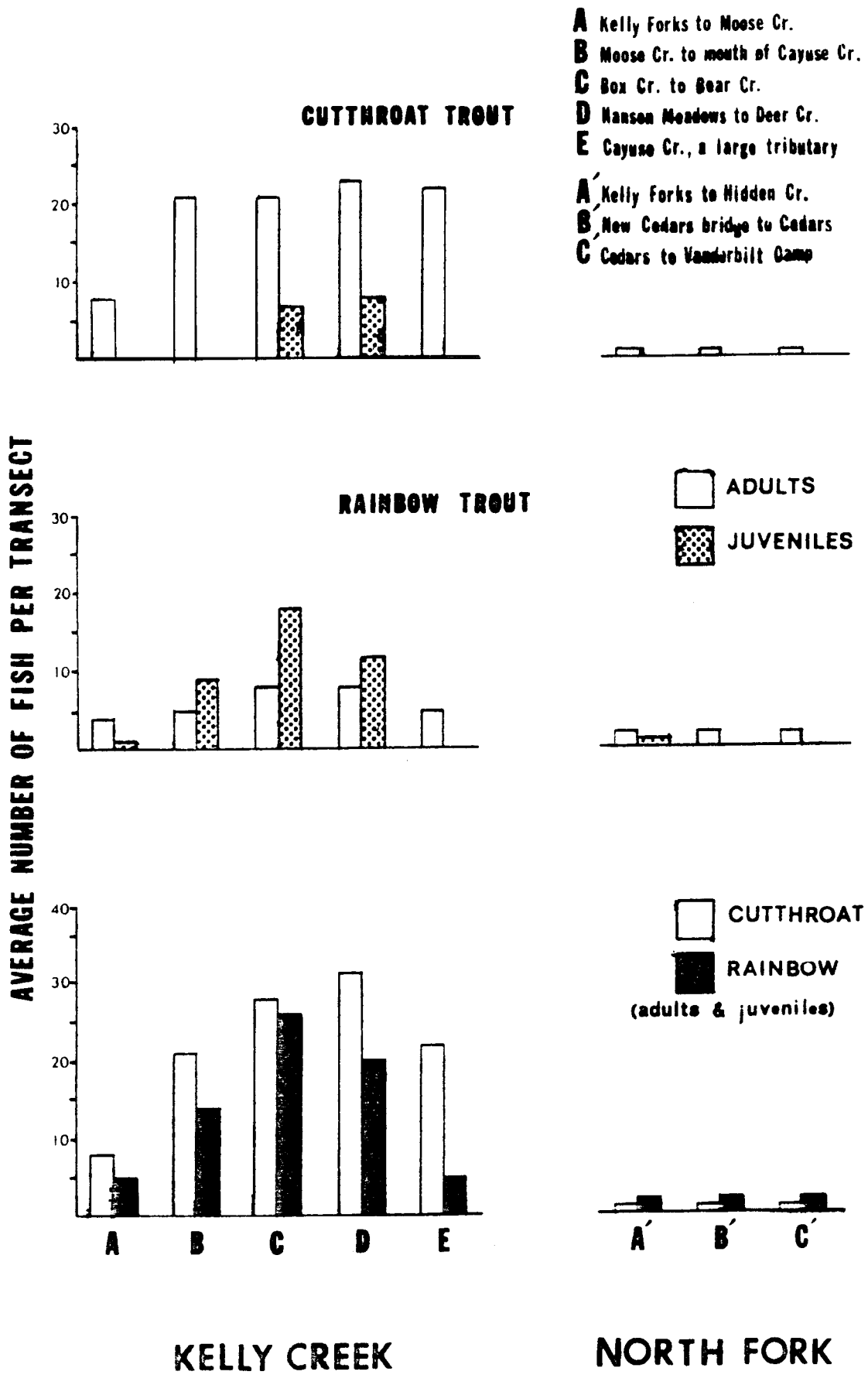


Figure 6. Average number of cutthroat and rainbow trout counted on the roadside of each snorkeling transect in Kelly Creek (Kelly Forks to Moose Creek) and the North Fork of the Clearwater River (Kelly Forks to Hidden Creek) during August, 1969 to 1975.



ire 7. The abundance per entire transect of adult and juvenile cutthroat rainbow trout in Kelly Creek (catch-and-release regulations) and the

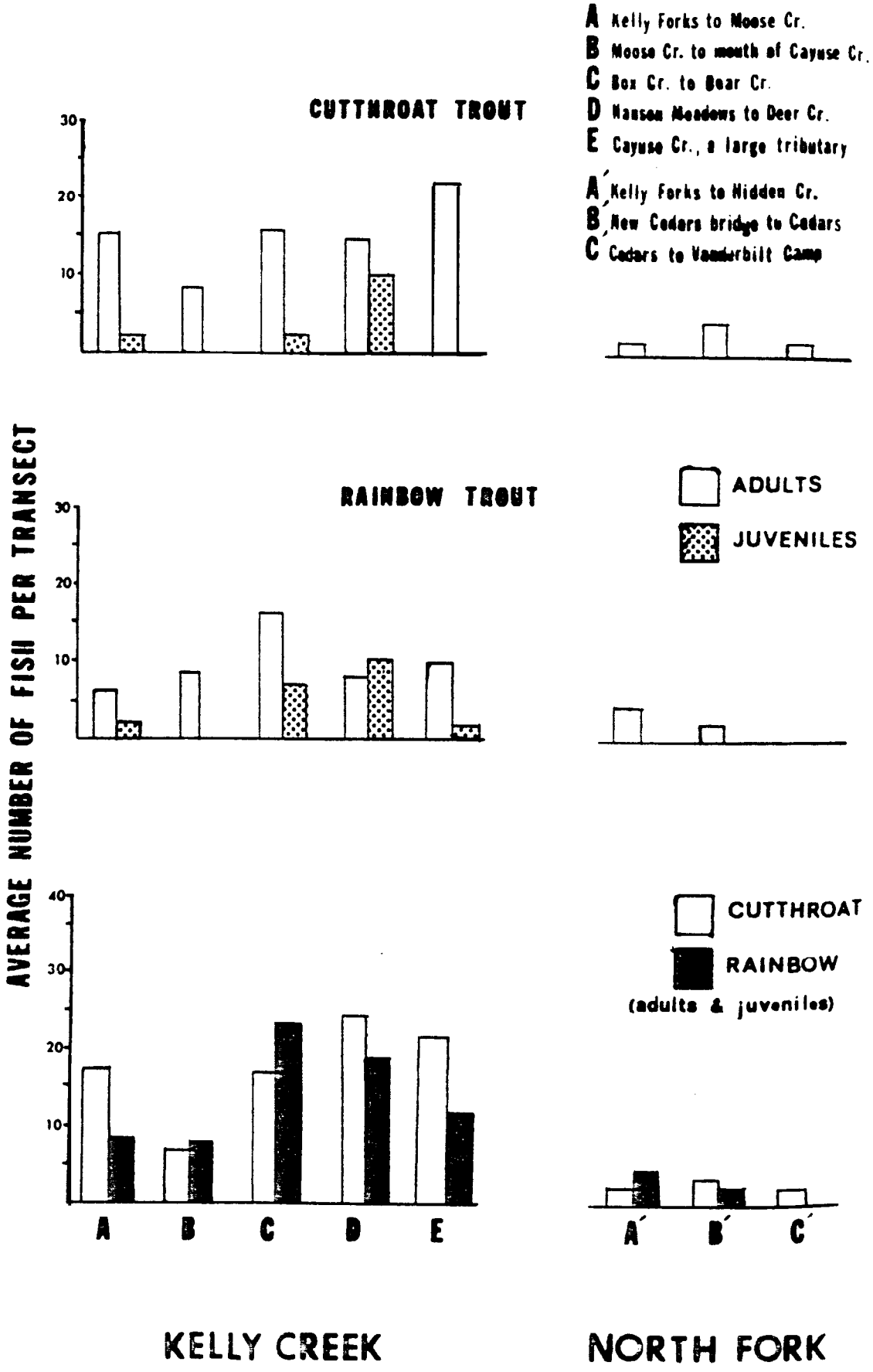


Figure 8. The abundance per entire transect of adult and juvenile cutthroat

Box Creek in 1975. We counted twice as many rainbow per transect and 4 times more juvenile rainbow per transect in Kelly Creek from Box Creek to Deer Creek than in the section from Kelly Forks to Moose Creek.

The counts of cutthroat and rainbow in upper sections of Kelly Creek were generally smaller in 1975 than in 1974 (Figs. 7 and 8). Stream flows in August of 1975 were unusually high in early August and fish may have been less concentrated in the pools we used as transects.

On the North Fork, cutthroat or rainbow were not more abundant in upper sections in 1974 or 1975 (Figs. 7 and 8). We counted no trout fry, juvenile cutthroat, or juvenile rainbow trout upstream from Hidden Creek.

Dolly Varden were more abundant in the North Fork study area than in the Kelly Creek study area. In August, 1975, we counted 47 Dolly Varden in 48 transects in the North Fork and 6 Dolly Varden in 38 transects in Kelly Creek.

St. Joe River

Abundance of cutthroat trout has increased 3 to 6 times since 1970 in various sections of the upper St. Joe River (Fig. 9). In the St. Joe River from Avery to Prospector Creek (access by road, standard angling regulations), we counted an average of 3 cutthroat trout, 35 hatchery rainbow trout, 44 whitefish, 9 squawfish, and 13 kokanee per transect in 1975; 6 times more cutthroat than in 1969. In the river from Prospector Creek to Spruce Tree Camp (access by road, special angling regulations), we counted 29 cutthroat, 9 rainbow, 18 whitefish, and 12 kokanee per transect in 1975; 5 times more cutthroat than in 1970. There were at least 41 juvenile cutthroat (age I and II) in the top 6 transects in this section in 1975. Most

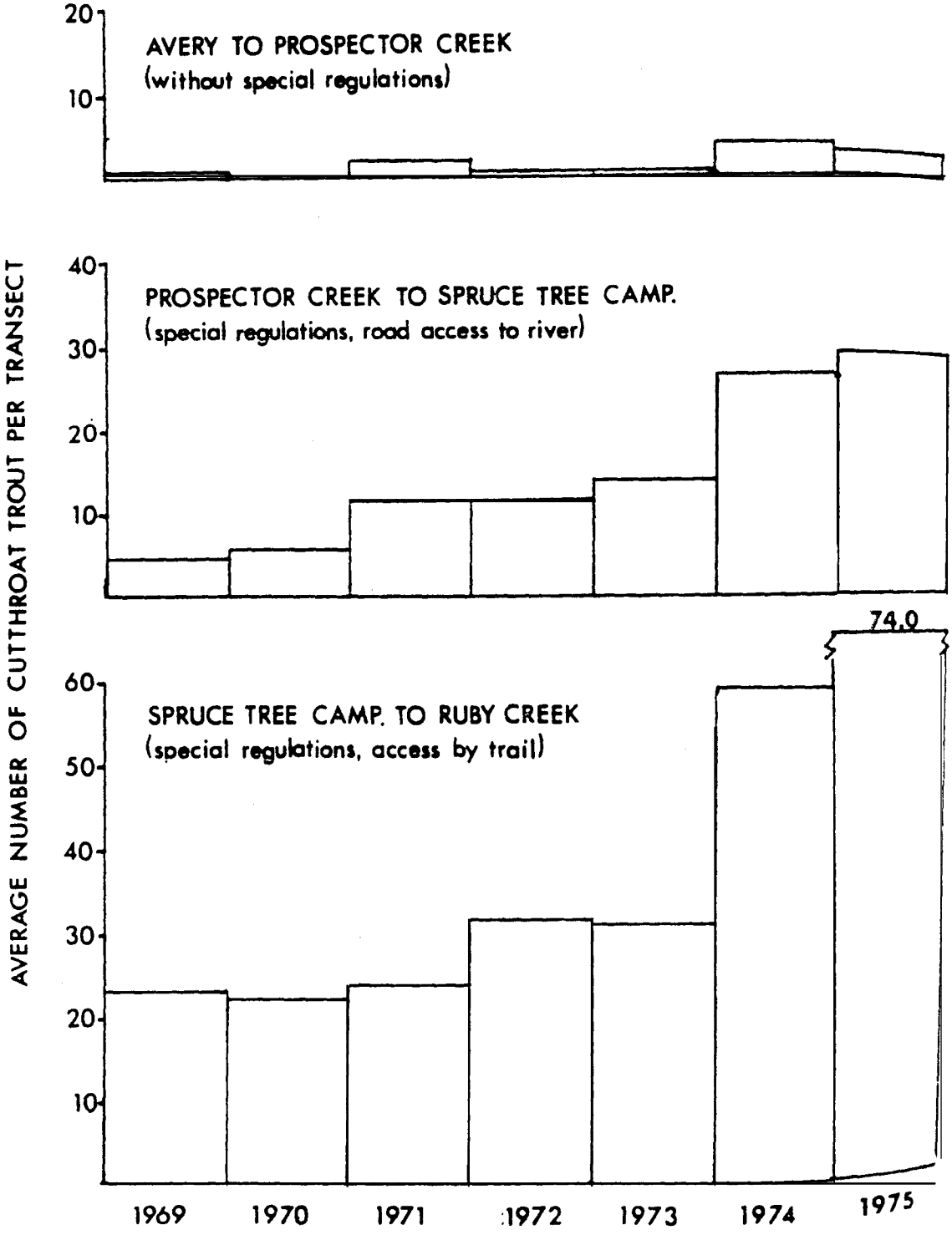


Figure 9. Average number of cutthroat trout per snorkeling transect for each study section of the St. Joe River from 1969 to 1975.

of the rainbow counted were of hatchery origin and had moved into the lower part of the special regulations area after being released downstream from Prospector Creek. In 1975, we counted 14 squawfish in the 15 transects from Prospector Creek to Spruce Tree Camp. In transects from Spruce Tree Camp to Ruby Creek (access by trail, special angling regulations), we counted an average of 54 adult cutthroat, 20 juvenile cutthroat, no rainbow, and 16 whitefish per transect in 1975. Cutthroat abundance in this section of river had more than tripled since 1970 (Fig. 9). In the transect at the mouth of Ruby Creek, we counted 12 age I cutthroat in 1974 and 15 age I cutthroat in 1975, noticeable increases over past years.

Size of Fish and Catch Rate

The mean size of cutthroat trout, number of large cutthroat trout, and catch rate of cutthroat per hour of fishing by project personnel increased in Kelly Creek and the upper St. Joe River as a result of catch-and-release and trophy-fish regulations.

Kelly Creek-North Fork

Catch-and-release regulations allowed cutthroat trout in Kelly Creek to live longer and thus the mean size of cutthroat increased. The mean length of cutthroat and rainbow trout caught by project personnel from Kelly Creek and the North Fork increased from 1970 to 1973, but in 1974 and 1975 there was a slight decrease in the mean length of fish measured (Table 16). We believe the smaller average size in 1974 and 1975 compared to 1973 was due to the larger number of juvenile cutthroat in the river in 1974 and 1975.

The number of large cutthroat trout in Kelly Creek increased since catch-and-release regulations were initiated in 1970. Of the cutthroat

Table 16. Mean total length of cutthroat trout and rainbow trout captured by project personnel in Kelly Creek and North Fork of the Clearwater River, 1970 to 1975.

	Kelly Creek		North Fork	
	Number	Length	Number	Length
Cutthroat trout				
1970	122	220 mm (8.7")	21	217 mm (8.5")
1971	217	240 mm (9.4")	36	226 mm (8.9")
1972	316	248 mm (9.8")	50	262 man (10.3")
1973	286	265 mm (10.4")	42	272 nun (10.7")
1974	3 02	256 mm (10.1")	9	223 nun (8.8")
1975	326	246 mm (9.7")	11	258 nun (10.2")
Rainbow trout				
1970	38	185 mm (7.3")	--	--
1971	49	249 rmn (9.8")	2	229 man (9.0")
1972	76	240 mm (9.4")	19	264 mm(10.4")
1973	143	259 mm (10.2")	36	270 man (10.6")
1974	47	220 nun(8.7")	7	223 nun (8.8")
1975	167	200 nun(7.9")	18	202 nun (8.0")

capture[d] from Kelly Creek by project personnel in 1970, 19.8% were longer than 254 mm (10 inches), 2.6% were longer than 330 mm (13 inches), and the longest cutthroat was 355 mm (14 inches). In 1975, 42.5% were longer than 254 mm, 5.8% were longer than 330 mm, and longest cutthroat caught was 432 mm (17 inches) (Table 17, Fig. 10). In 1975, project personnel caught more large cutthroat in sections of Kelly Creek with access by trail than in the section with access by road (Table 18, Fig. 10).

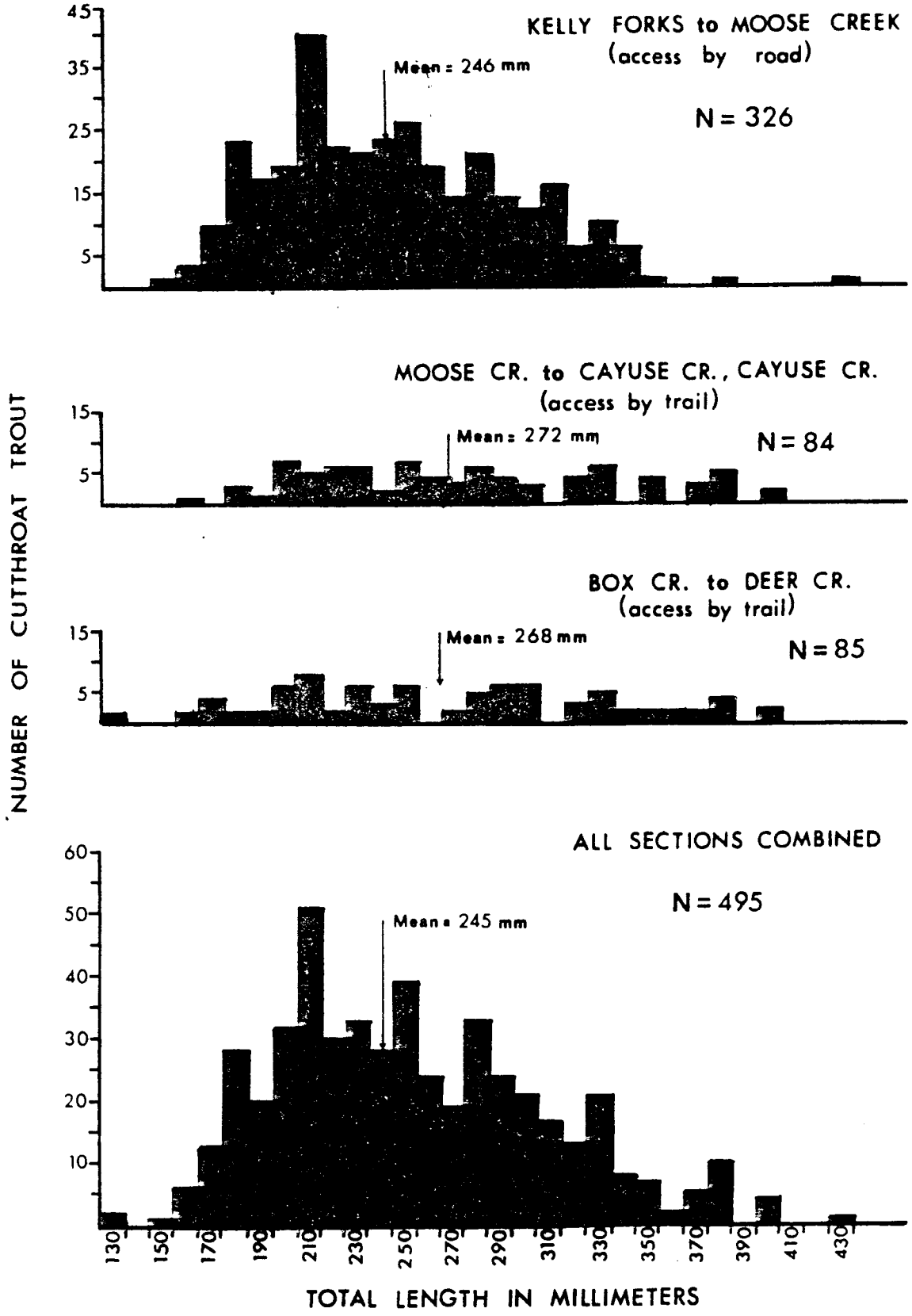
Rainbow trout captured from Kelly Creek (Kelly Forks to Moose Creek) by project personnel were slightly longer in 1975 compared to 1970 (Table 16). Most rainbow trout captured by project personnel in 1975 were shorter than 210 mm (Fig. 11).

Small numbers of cutthroat and rainbow trout collected from the North Fork limit meaningful comparisons. Cutthroat captured by project personnel in 1974 (n = 9) and 1975 (n = 21) ranged from 140 mm to 310 mm total length.

Catch of all fish per hour by project personnel declined on Kelly Creek and the North Fork because of the reduced abundance of rainbow-steelhead in the streams, but the catch rate for cutthroat increased on Kelly Creek and remained unchanged on the North Fork (Table 19). Fishing with standardized methods on Kelly Creek, project personnel caught 7.2 fish/hour and 0.6 cut-throat/hour in 1969 versus 4.8 fish/hour and 2.4 cutthroat/hour in 1975. While fishing the North Fork with standardized methods, project personnel caught 4.4 fish/hour and 0.2 cutthroat/hour in 1969 versus 1.1 fish/hour and 0.4 cutthroat/hour in 1975 (Table 19). Low water flows and the abundance of shiners in the streams in 1973 influenced the distribution and catchability of cutthroat trout in Kelly Creek and the North Fork that year.

Table 17. Numbers and percentages of cutthroat trout longer than specified total lengths captured by project personnel from Kelly Creek (Kelly Forks to Moose Creek) in 1970 and 1975.

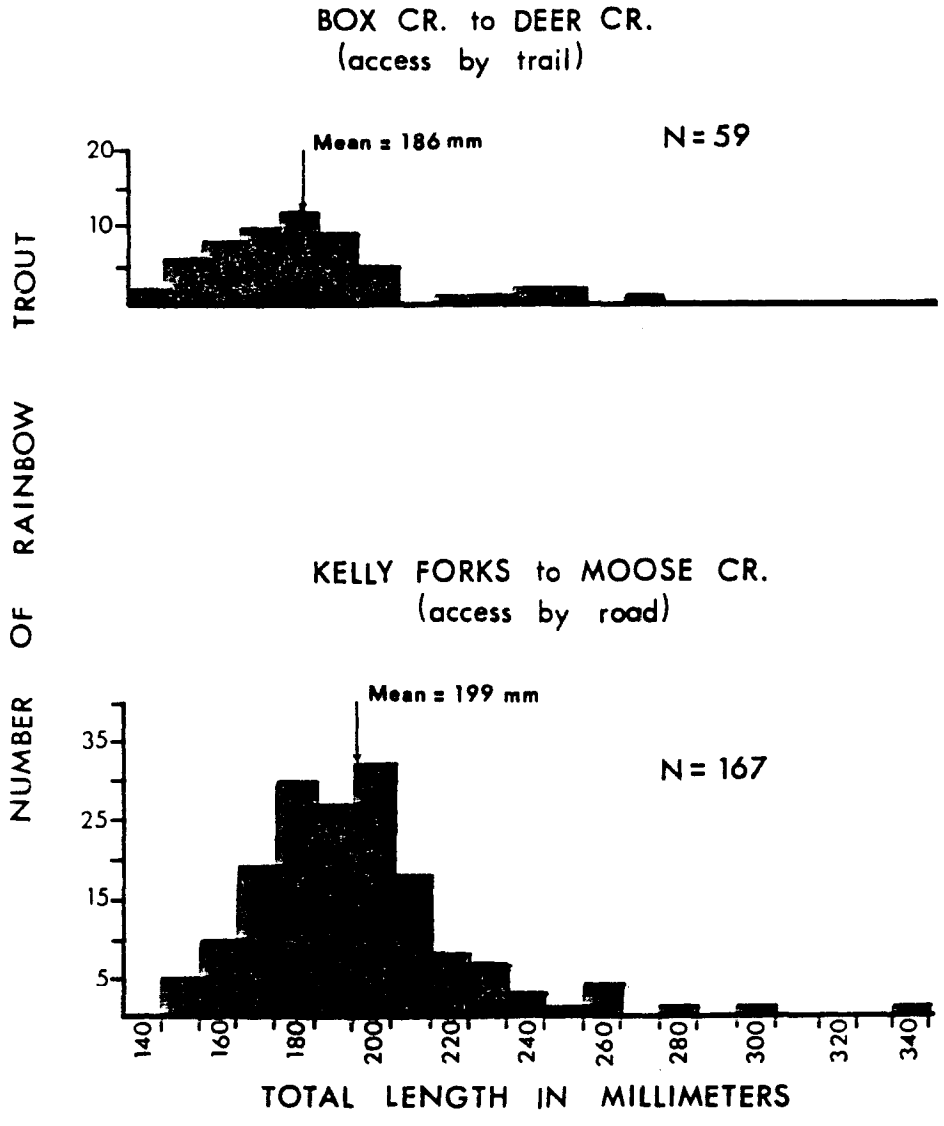
Fish longer than	1970 Number (N=116)	1970 Percentage	1975 Number (N=326)	1975 Percentage
250 mm (10")	23	19.8	138	42.3
281 mm (11")	11	9.5	87	26.7
305 mm (12")	8	6.9	48	14.7
330 mm (13")	3	2.6	19	5.8
355 mm (14")	2	1.7	3	0.9
381 mm (15")	0	0	1	0.3
406 mm (16")	0	0	1	0.3
432 mm (17")	0	0	1	0.3
457 mm (18")	0	0	0	0



ure 10. Length-frequency of cutthroat trout captured by project personnel each study section of Kelly Creek in 1975.

Table 18. Numbers and percentages of cutthroat trout longer than specified total lengths captured by project personnel from each study section of Kelly Creek in 1975.

Fish longer than	Kelly Forks to Moose Creek (access by road)		Moose Creek to Cayuse Creek and Cayuse Creek (access by trail)		Box Creek to Deer Creek (access by trail)	
	Number ($N=326$)	Percentage	Number ($N=84$)	Percentage	Number ($N=85$)	Percentage
250 mm (10")	138	42.3	52	61.9	44	51.8
281 mm (11")	87	26.7	39	46.4	38	44.7
305 mm (12")	48	14.7	28	33.3	26	30.6
330 mm (13")	19	5.8	20	23.8	19	22.4
355 mm (14")	3	0.9	14	16.7	10	11.8
381 mm (15")	1	0.3	7	8.3	5	5.9
406 nun (16")	1	0.3	2	2.4	2	2.4
432 mm (17")	1	0.3	0	0	0	0
457 mm (18")	0	0	0	0	0	0



e 11. Length-frequency of rainbow trout captured by project personnel udy sections of Kelly Creek in 1975.

Table 19. Fish per hour, cutthroat per hour, and species composition of the catch of project personnel fishing 35-60 man hours in transects **in** Kelly Creek and the North Fork of the Clearwater River, 1969 to 1973 and 1975. We standardized the effort by fishing one-half hour with a nickel "Mepps" spinner (size 0) and one-half hour with a "Renegade" fly (size 10 or 12) in the transects each year.

	Kelly Creek					
	1969	1970	1971	1972	1973	1975
Hours fished	50	60	40	40	40	35
Fish per hour	7.2	8.3	6.5	6.3	1.9	4.8
Cutthroat per hour	0.6	0.7	1.0	2.3	1.0	2.4
Species composition						
Rainbow-steelhead	89.77.	89.87.	81.97.	56.17	37.7%	47.9
Cutthroat trout	8.6	8.4	15.4	42.3	51.9	49.
Mountain whitefish	1.3	1.8	2.3	1.3	9.1	--
Dolly Varden	0.4	0.0	0.4	0.3	1.3	--
Cutthroat x rainbow	--	--	--	--	--	2.4
	North Fork					
Hours fished	50	60	36	35	38	35
Fish per hour	4.4	4.1	4.3	2.1	1.4	1.
Cutthroat per hour	0.2	0.4	0.7	1.5	0.5	0.4
Species composition						
Rainbow-steelhead	91.17.	74.77	80.670	48.07.	32.7%	35•
Cutthroat trout	3.3	9.4	15.6	40.0	34.6	33.
Mountain whitefish	4.2	13.9	1.9	8.0	23.6	10.
Dolly Varden	1.4	2.0	1.9	3.0	9.1	20.

In 1975 catch rates of project personnel were higher in sections of Kelly Creek with access by trail than in the section with access by road, but about the same in all sections of the North Fork. While fishing with only flies in 1975, project personnel caught 4.1 trout/hour and 2.8 cutthroat/hour from Kelly Creek between Moose Creek and the mouth of Cayuse Creek and in Cayuse Creek, 7.0 trout/hour and 4.8 cutthroat/hour from Kelly Creek between Box Creek and Bear Creek, and 6.8 trout/hour and 3.0 cutthroat/hour from Kelly Creek between Hanson Meadows and Deer Creek. In all sections of the North Fork, project personnel caught an average of 1.2 fish/hour and 0.5 cutthroat/hour in 1975.

St. Joe River

The mean size of cutthroat trout increased in sections of the St. Joe River under trophy-fish regulations. The mean length of cutthroat measured by project personnel increased from 1969 to 1973, but decreased slightly in 1974 and 1975 (Table 20). We believe the smaller average size in 1974 and 1975 compared to 1973 was due to the larger number of juvenile cutthroat in the river in the latter years.

The St. Joe River contained more large cutthroat trout and more cutthroat of the established trophy size of 13 inches in 1975 compared to 1969-1970. Before trophy-fish regulations (1969 and 1970), 2.5% of the cutthroat measured were longer than 254 mm (10 inches), 0.1% were longer than 330 mm (13 inches), and no fish captured by project personnel were longer than 355 mm (14 inches). In 1975, 17.7% of the cutthroat trout we captured were longer than 254 mm, 1.5% were 330 mm or longer, and we caught and released 2 cutthroat longer than 355 mm (Table 21, Fig. 12). Overall, there was a larger

Table 20. Mean total length of cutthroat trout captured by project personnel in study sections of the St. Joe River under the trophy-fish regulation, 1969 to 1975.

Year	Prospector Creek-Spruce Tree		Spruce Tree-Ruby Creek	
	Number	Length	Number	Length
1969-1970	1152	185 mm (7.3")	324	201 mm (7.9")
1971	32	201 mm (7.9")	20	170 mm (6.7")
1972	143	254 mm (10.0")	179	225 mm (8.9")
1973	59	221 mm (8.7")	80	246 mm (9.7")
1974	296	219 mm (8.6")	284	234 mm (9.2")
1975	306	199 mm (7.8")	237	205 mm (8.1")

Table 21. Numbers and percentages of cutthroat trout longer than specified total lengths captured by project personnel from sections of the upper St. Joe River under the trophy-fish regulations, 1969-1970 and 1975.

Fish longer than	1969-1970		1975	
	Number ($\bar{N}$=805)	Percentage	Number (N=543)	Percentage
250 mm (10")	20	2.5	96	17.7
281 mm (11")	7	0.9	57	10.5
305 mm (12")	3	0.4	30	5.5
330 mm (13")	1	0.1	8	1.5
355 mm (14")	0	0	2	0.4
381 mm (15")	0	0	0	0

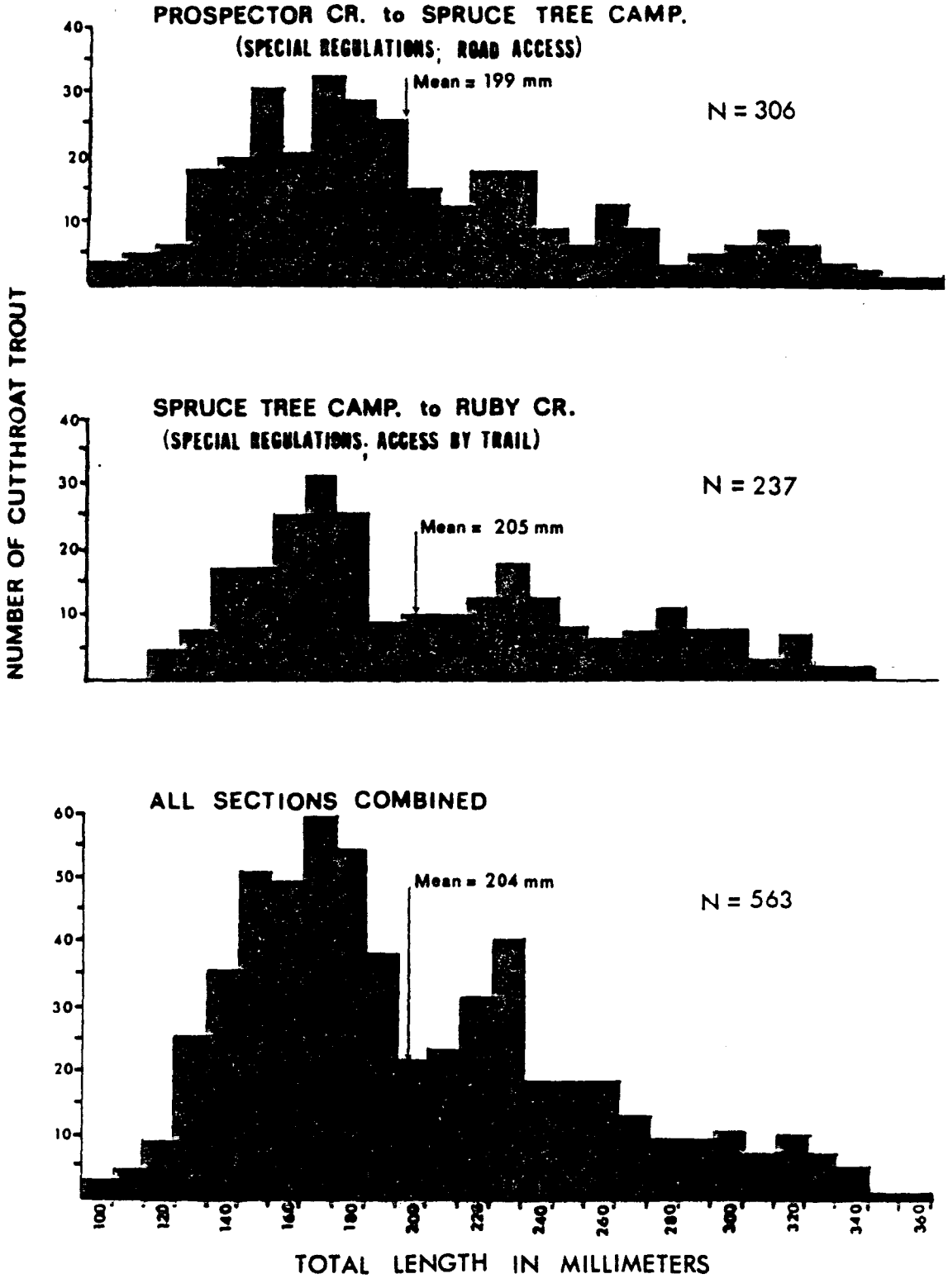


Figure 12. Length-frequency of cutthroat trout captured by project personnel in each study section of the upper St. Joe River in 1975.

proportion of large cutthroat in the section of the St. Joe River with access by trail, but we caught more cutthroat longer than 330 mm in sections with access by road (Table 22, Fig. 12).

In 1975, project personnel caught and released 3.5 cutthroat/hour in all sections of the St. Joe River covered by trophy-fish regulations. We caught more cutthroat per hour as we moved upstream: 2.5 cutthroat/hour from Prospector Creek to Gold Creek (access by paved road), 2.7 cutthroat/hour from Gold Creek to Spruce Tree Camp (access by unpaved road), and 5.4 cutthroat/hour from Spruce Tree Camp to Ruby Creek (access by trail). Project anglers caught 0.05 cutthroat longer than 13" ("keepers") per hour in 1975. Our catch rate for "keepers" as minimal as project personnel tried to catch all sizes of cutthroat rat: ar than concentrating on larger cutthroat.

Movement of Tagged Cutthroat Trout

From our tagging studies in all three streams, there appears to b.' pattern of movement upstream into the upper drainages (study areas) in the spring and early summer, little or no movement during the summer, and movement downstream to the lower drainages in the fall.

Kelly Creek-North Fork

Cutthroat tagged in the North Fork of the Clearwater River downstream from Kelly Forks in spring and early summer and recaptured in July and August of the same year were usually recaptured upstream from the tagging sites. Most cutthroat tagged in July and August and recaptured those same month had not moved. Cutthroat tagged during the summer and recaptured in the fall of the same year had usually moved downstream from the tagging sites (Fig. 13). Cutthroat tagged during the summer and recaptured the following spring

Table 22. Numbers and percentages of cutthroat trout longer than specified total lengths captured by project personnel from study sections of the upper St. Joe River under the trophy-fish regulations, 1975.

Fish longer than	Prospector Creek-Spruce Tree (access by road)		Spruce Tree-Ruby Creek (access by trail)	
	Number (N=306)	Percentage	Number (N=237)	Percentage
250 mm (10")	49	16.0	47	19.8
281 mm (11")	27	8.8	30	12.7
305 mm (12")	19	6.2	11	4.6
330 mm (13")	5	1.6	3	1.3
355 mm (14")	2	0.7	0	0
381 mm (15")	0	0	0	0
406 mm (16")	0	0	0	0

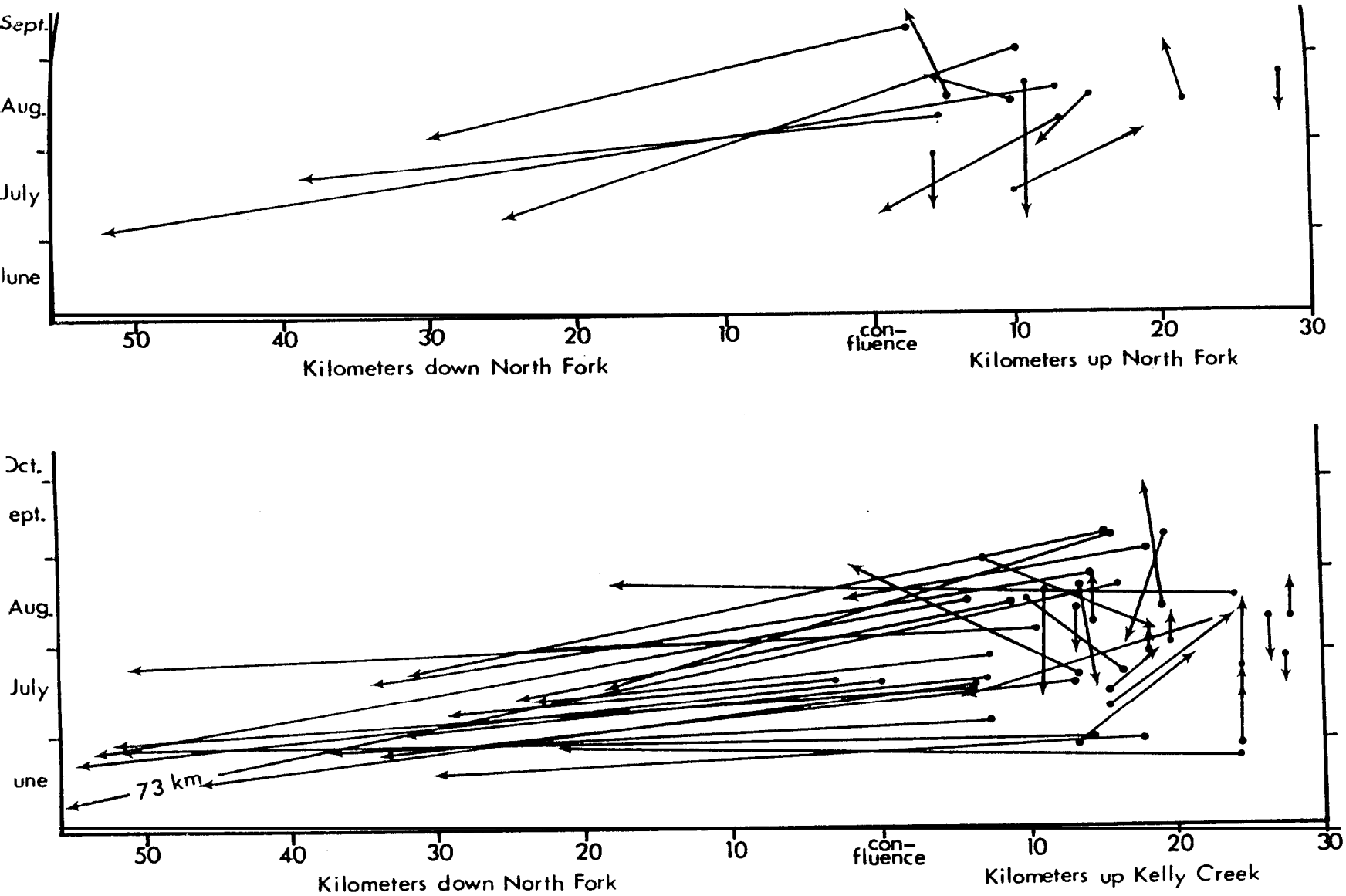


Figure 14. Date and location of cutthroat trout when tagged (.) and recaptured ( ) in Kelly Creek and the North Fork of the Clearwater River from 1970 to 1975. All movements (——) are for fish tagged one year and recaptured the next year. An additional 49 fish recaptured in Kelly Creek exhibited the same pattern as others already shown and were not included.

or early summer were often recaptured downstream from the release sites (Fig, 14).

Most cutthroat tagged and recaptured the same year were recaptured during the summer within 2 km of the release site. Many cutthroat tagged one year and recaptured the next year were recaptured more than 10 km from the tagging sites (Table 23).

Table 23. Distance moved by cutthroat trout tagged and recaptured in Kelly Creek and the North Fork of the Clearwater River from 1970 to 1975.

Number of kilometers between release and recapture sites		Number tagged and recaptured in same year	Number tagged one year and recaptured the next year
10+	Upstream	11	8
5-10	Upstream	1	3
2-5	Upstream	2	2
Within 2		77	28
2-5	Downstream	4	4
5-10	Downstream	3	4
10-25	Downstream	7	11
25+	Downstream	1	63

Many of the cutthroat tagged and released during the summer in Kelly Creek were recaptured downstream from Kelly Forks during spring and fall migrations through the North Fork of the Clearwater River. To protect cut-throat moving out of the catch-and-release area in the fall, the Idaho Fish and Game Commission initiated an early season closure (September il) on the North Fork of the Clearwater River downstream from Kelly Forks in 1971.

Cutthroat trout usually return to their home drainage in the spring after overwintering in the North Fork of the Clearwater River downstream from Kelly Forks. Since 1970, of 264 trout tagged and recaptured in the Kelly Creek-North Fork study area, only 9 cutthroat (3.4%) tagged in Kelly Creek were recaptured in the North Fork study area or vice versa.

In 1975, we counted all of the Kelly Creek transects in August, September, and October to assess fish movement in the fall. We noted several changes in the abundance of the fish species in September and October compared to August: (1) we counted progressively fewer cutthroat and rainbow trout in September and October in the Box Creek to Deer Creek, Cayuse Creek, and Kelly Forks to Moose Creek transects, but more cutthroat and fewer rainbow from Moose Creek to the mouth of Cayuse Creek; (2) in mid-September when water temperatures dipped to 7° C, we counted no suckers in the Box Creek to Deer Creek and Cayuse Creek transects, and fewer suckers from Kelly Forks to the mouth of Cayuse Creek; (3) we counted no squawfish in any sections in September or October; and (4) we observed spawning aggregations of whitefish at heads of larger pools from Kelly Forks to the mouth of Cayuse Creek in September and October (Table 24).

The decreased numbers of cutthroat trout we observed in October compared to August in Kelly Creek substantiate our conclusions from tagging data that many cutthroat move downstream in the fall. Increasing numbers of cutthroat from August to October in the section from Moose Creek to the mouth of Cayuse Creek indicate that cutthroat move from upper portions of Kelly Creek and hold in deeper pools of lower sections before migrating downstream into the North Fork of the Clearwater River. It appears that rainbow trout also move downstream in the fall to overwinter in the main North Fork

Table 24. Numbers of fish observed in the snorkeling transect counts in each section of Kelly Creek in August, September, and October, 1975.

Section and month	Cutthroat trout	Rainbow trout	Whitefish	Suckers	Squawfish
Box Creek to Deer Creek					
August	119	123	152	14	0
September	61	22	108+	0	0
October	6	5	23	0	0
Cayuse Creek (a tributary)					
August	124	66	204	24	17
September	65	13	130+	0	0
October	14	0	3	0	0
Moose Creek to Cayuse Creek					
August	46	49	190	166	44
September	76	18	200+	40	0
October	79	0	400+	0	0
Kelly Forks to Moose Creek					
August	355,	173	669	649	170
September	179	33	600+	76+	0
October	120	1	600+	56	0
ALL SECTIONS COMBINED					
August	644	411	1215	853	231
September	381	86	1038+	116+	0
October	219	6	1026+	56	0

(Table 24). At water temperatures below 5° C some salmonids enter interstices of the substrate (Everest 1969, Miller 1970, Mauser 1972, Morrill 1972), accounting in part for the reduced number of cutthroat and rainbow observed in our fall snorkeling counts.

St. Joe River

Cutthroat trout in the St. Joe River had the same seasonal movement patterns as fish in the North Fork drainage. Cutthroat tagged in early summer and recaptured in July and August of the same year were often recaptured upstream. Most cutthroat tagged in July and August and recaptured those same months had not moved. Most cutthroat tagged during the summer and recaptured in September and October of the same year had moved downstream (Fig. 15). Cutthroat tagged in September and recaptured the next summer had moved upstream. Cutthroat tagged one summer were often recaptured in the same location the next summer. Cutthroat tagged during one summer and recaptured the spring and early summer of the next year had moved downstream from the release sites (Fig. 16).

Most cutthroat tagged and recaptured the same year were recaptured during the summer within 2 km of the release site. Some cutthroat tagged one year and recaptured the next year were recaptured more than 10 km from the tagging site (Table 25). One cutthroat tagged during the summer was recaptured in October, 116 km downstream from the release site.

Age-Growth of Cutthroat Trout

Belly Creek

Since we could not obtain accurate back-calculated lengths for ages I, II, and III using the body-scale relationship from 1975 data, we used

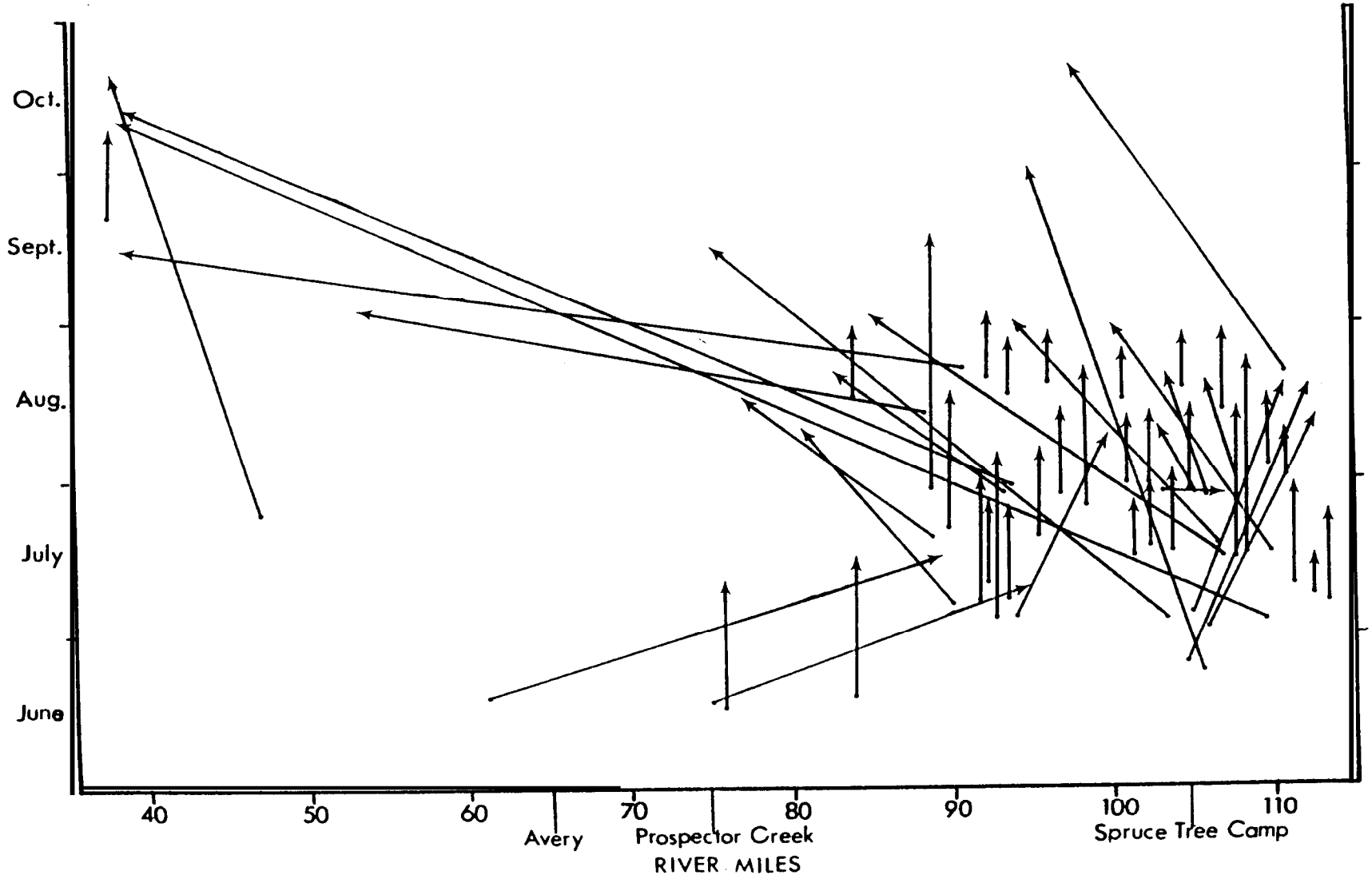


Figure 15. Date and location of cutthroat trout when tagged (.) and recaptured ( ) in the St. Joe River from 1969 to 1975. All movements (——) are within the year of tagging. An additional 82 cut-[illegible] exhibited the same pattern as others. Almost all were not recaptured.

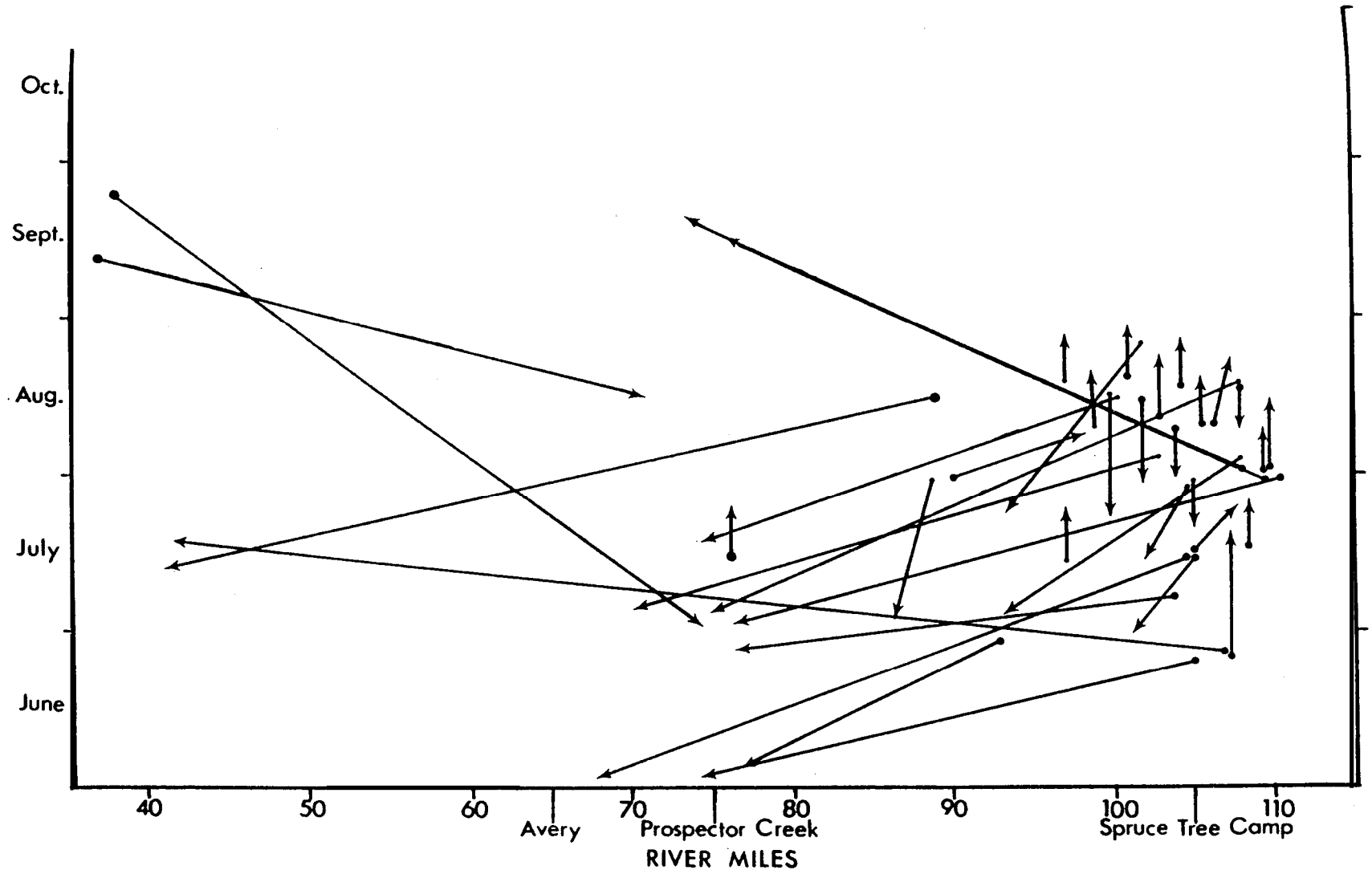


Figure 16. Date and location of cutthroat trout when tagged (.) and recaptured ( ) in the St. Joe River from 1969 to 1975. All movements (——) are for fish tagged one year and recaptured the next year. An additional 22 fish exhibited the same pattern as others already shown and were not included.

Table 25. Distance moved by cutthroat trout tagged and recaptured in the St. Joe River from 1969 to 1975.

Number of kilometers between release and recapture sites		Number tagged and recaptured in same year	Number tagged one year and recaptured the next year
10+	Upstream	3	3
5-10	Upstream	3	1
2-5	Upstream	5	4
Within 2		92	29
2-5	Downstream	11	3
5-10	Downstream	2	3
10-25	Downstream	8	2
25+	Downstream	5	11

the regression equation Ball (1971) calculated from 1969-1970 data to calculate lengths at each annulus and increments of growth for 208 cutthroat collected from Kelly Creek in 1975 (Table 26). During the first two years in the river (4th and 5th years of life), cutthroat grew about 55 mm a year. Rate of growth was slower during the fish's sixth year of life. The average increment of growth for eight cutthroat in our 1975 sample which completed a sixth year of life was 54 min. Regeneration and reabsorption was common in the scales of the largest cutthroat. We did not age any cutthroat older than six years, but we believe that some cutthroat may live to age VII and older.

Thirty-six percent (75) of the 208 cutthroat we aged had formed an annulus after the first growing season, and these fish averaged 66 mm at that time. These cutthroat emerged earlier and/or grew faster than those cutthroat not forming a first annulus.

St. Joe River

Using the calculated body-scale regression equation in Figure 5, I back-calculated the lengths at each annulus for 446 cutthroat collected from the upper St. Joe River in 1975 and computed annual increments of growth (Table 27). During the first three years in the river (3rd, 4th, and 5th years of life), the average cutthroat grew about 60 nun a year. Rate of growth declined as fish neared the end of its life span of six years. Regeneration and reabsorption was common in the scales of the largest cutthroat in 1975. We did not age any cutthroat older than six years, but we believe that some cutthroat may live to age VTI and older.

Of 446 cutthroat examined in 1975, 151 (33.9%) had formed an annulus after the first growing season, and these fish averaged 67 mm at that time. Aankel (1971) found that 40.3% of the St. Joe River cutthroat he aged in 1969 and 1970 had formed an annulus after the first summer.

Table 26. Calculated total lengths and annual increments of growth for cutthroat trout collected from Kelly Creek (Kelly Forks to Moose Creek) in 1975.

Age class	Number of fish	Mean TL at capture (mm)	Calculated mean length at each annulus (mm) 1	2	3	4	5	6
I	0							
II	26	182	70.6	121.8				
III	97	211	65.9	101.5	161.3			
IV	65	248	64.8	96.6	148.2	219.8		
V	12	292	63.8	88.0	129.5	189.4	250.6	
VI	8	328	64.1	92.8	136.2	187.6	252.5	305.8
Weighted mean length			66.2	101.4	153.4	212.5	251.4	305.8
Increment of growth			66.2	35.2	52.0	59.1	38.9	54.4
Number of fish			75	208	182	85	20	8

Table 27. Calculated total lengths and annual increments of growth for cutthroat trout collected from the special regulations area of the upper St. Joe River, 1975.

Age class	Number of fish	Mean TL at capture (mm)	Calculated mean length at each annulus (mm) 1	2	3	4	5	6
I	0							
II	81	147	68.4	112.3				
III	256	189	66.8	103.9	163.9			
IV	58	260	67.0	99.6	156.7	221.1		
V	29	311	66.5	99.0	154.0	224.0	288.1	
VI	2	370	62.3	93.4	139.1	214.2	224.6	307.5
Weighted mean length			67.2	104.3	161.5	221.7	287.2	307.5
Increment of growth			67.2	37.1	57.2	60.2	65.5	20.3
Number of fish			151	446	365	109	31	2

Cutthroat reared two or three years in tributaries before migratins into Kelly Creek and the St. Joe River. Faster growing cutthroat left the tributaries at the beginning of their third growing season (age II) and slow growing cutthroat left after their third year of life (age III) (Tables 28, 29, and 30). Cutthroat rearing in tributaries for two and three years are hereafter referred to as Trib 2 and Trib 3 cutthroat, respectively. Since the initiation of special angling regulations, more cutthroat entered Kelly Creek and the St. Joe River after only two years of growth in tributaries. Ball (1971) reported that cutthroat reared in the headwaters or tributaries for three years before entering Kelly Creek. In our 1975 sample {182 cutthroat examined), 307 spent two years and 70% three years in tributaries before entering Kelly Creek. In 1969-1970, of 166 cutthroat in the St. Joe River checked by Rankel (1971), 17% had spent two years, 68% three years, and 5% four years in tributaries before migrating to the main river. In 1975, of 440 cutthroat we examined, 40% had spent two years, 59% three years, and 1% four years in tributaries before entering the upper`St. Joe River.

It is possible that increased densities of cutthroat rearing in the tributaries, a result of catch-and-release and trophy-fish regulations, and decreased growth rates of cutthroat in the tributaries. Cutthroat collected from Kelly Creek in 1975 were significantly smaller at annuli I and II com-pared to cutthroat collected in 1969-1970 (Table 31). Although cutthroat collected in 1975 were significantly smaller at annuli I and II in a statistical sense, differences in length at annuli I (2.7 mm) and II (4.4 mm) may not be biologically significant. On the St. Joe River, Trib 2 cutthroat collected in 1975 were significantly smaller at annuli I and II, and the

Table 28. The mean scale radius measurements (in imn at 81X magnification) at each annulus of cutthroat trout collected from Kelly Creek in 1975 for cutthr[oat] which spend 2 years versus 3 years in tributaries before entering the main river, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
2 years in tributaries (a)	8.48	20.54	38.49	54.77	--
3 years in tributaries (b)	7.34	16.06	29.91	46.92	--
Calculated total length (mm)					
2 years in tributaries	68.5	111.7	176.0	234.3	--
3 years in tributaries	64.4	95.7	145.3	206.2	--
Xa - Xb	+1.14	+4.48	+8.58	+7.85	--
Sd	0.20	0.50	0.98	2.37	--
df	133	194	170	76	--
Computed t	5.87	9.02	8.74	3.31	--
Probability of larger t	<0.001	<0.001	<0.001	<0.001	--

Table 29. The mean scale radius measurements (in mm at 81X magnification at each annulus of cutthroat trout collected from the upper St. Joe River in 1969-1970 for cutthroat which spend 2 years versus 3 years in tributar: before entering the main river, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alo:

	Annuli				
	I	II	III	IV	V
Mean scale radius					
2 years in tributaries (a)	12.53	25.82	43.08	62.77	--
3 years in tributaries (b)	11.55	20.23	34.45	52.41	--
Calculated total length (=)					
2 years in tributaries	86.2	134.8	198.0	270.1	--
3 years in tributaries	82.6	114.4	166.4	232.2	--
Xa - Xb	+0.98	+5.59	+8.63	+10.36	--
Sd	0.49	0.82	1.49	3.31	--
df	44	138	134	60	--
Computed t	1.98	6.83	5.79	3.13	--
Probability of larger t	0.1-0.05	<0.001	40.001	0.01-0.001	--

Table 30. The mean scale radius measurements (in mm at 81X magnification) at each annulus of cutthroat trout collected from the upper St. Joe River in 1975 for cutthroat which spend 2 years versus 3 years in tributaries before entering the main river, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
2 years in tributaries (a)	7.55	20.04	40.75	57.29	76.67
3 years in tributaries (b)	7.18	15.73	30.32	48.33	66.46
Calculated total length (mm)					
2 years in tributaries	68.0	113.7	189.5	250.0	320.9
3 years in tributaries	66.6	97.9	151.3	217.2	283.6
Xa - Xb	+0.37	+4.31	+10.43	+8.96	+10.21
3d	0.11	0.28	0.51	1.53	4.73
If	348	439	356	104	29
Computed t	3.50	15.14	20.56	5.86	2.16
Probability of larger t	<0.001	< 0.001	<0.001	<0.001	0.05-0.02

Table 31. The mean scale radius measurements (in mm at 81X magnification) at each annulus of Kelly Creek cutthroat trout collected in 1975 versus 1969-1970, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
1975 (a)	7.82	17.66	32.19	48.68	59.55
1969-1970 (b)	8.59	18.88	31.18	44.58	59.00
Calculated total length					
1975	66.2	101.4	153.4	212.4	251.4
1969-1970	68.9	105.8	149.8	197.8	249.4
Xa - Xb	-0.77	-1.22	+1.01	+4.10	+0.55
Sd	0.20	0.43	0.71	1.66	3.93
df	250	336	305	114	21
Computed t	3.80	2.87	1.42	2.47	0.14
Probability of larger t	<0.001	0.01-0.001	0.2-0.1	0.02-0.01	0.9-0.7

increment of growth between annuli I and II was significantly smaller than Trib 2 cutthroat collected in 1969-1970 (Tables 32 and 33). Trib 3 cutthroat collected from the St. Joe River in 1975 were significantly smaller at annuli I, II, and III and increments of growth between annuli I and II and between annuli II and III were significantly smaller than for Trib 3 cutthroat collected in 1969-1970 (Tables 34 and 35).

Slower growth of cutthroat while in tributaries in recent years was compensated for during growing seasons in the main rivers. Cutthroat collected in 1975 appear to have grown faster during their first and/or second growing seasons in Kelly Creek and the St. Joe River than fish collected in 1969-1970. In Kelly Creek, the increment of growth of cutthroat collected in 1975 was larger by an average of 10 mm between annuli II and III and larger by an average of 13 mm between annuli III and IV compared to cutthroat collected in 1969-1970 (Table 36). As a result of increased growth rates between annuli II and IV, cutthroat collected in 1975 were significantly larger at age IV than cutthroat collected in 1969-1970 (Table 31). Since more cutthroat collected in 1975 entered Kelly Creek after rearing for 2 years in tributaries, the increased growth rate between annuli II and III indicates mainly that age II cutthroat grew faster in Kelly Creek than in tributaries. It is possible that the decline in abundance of steelhead in telly Creek reduced inter-specific competition with cutthroat and allowed

vtthroat to grow faster. On the St. Joe River, the increment of growth was 'ignificantly larger between annuli II and III and the same between annuli ZI and IV for Trib 2 cutthroat collected in 1975 than for such fish collected A 1969-1970 (Table 33). The increment of growth of Trib 3 cutthroat col-

ected in 1975 was significantly larger between annuli III and IV and between

Table 32. The mean scale radius measurements (in mm at 81X magnification) at each annulus of cutthroat trout which spend 2 years in tributaries befor, entering the main river and were collected in the upper St. Joe River in 1975 versus 1969-1970, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	V
Mean scale radius					
1975 (a)	7.55	20.04	40.75	57.29	--
1969-1970 (b)	12.53	25.82	43.08	62.77	--
Calculated total length (mm)					
1975	68.0	113.7	189.5	250.0	--
1969-1970	86.2	134.8	198.0	270.1	--
Xa - Xb	-4.98	-5.78	-2.33	-5.48	--
Sd	0.30	0.69	1.24	3.51	--
df	183	205	118	28	--
Computed t	16.60	8.38	1.88	1.56	--
Probability of larger t	<0.001	<0.001	0.1-0.05	0.2-0.1	--

Table 33. The mean scale measurements (in mm at 81X magnification) between consecutive annuli of cutthroat trout which spend 2 years in tributaries before entering the main river and were collected in the upper St. Joe River in 1975 versus 1969-1970, difference in increment measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli			
	I to II	II to III	III to IV	IV to V
Mean scale increment				
1975 (a)	12.56	20.31	17.82	--
1969-1970 (b)	15.12	17.00	18.00	--
Increment of growth (mm)				
1975	46.0	74.3	65.2	--
1969-1970	55.3	62.2	65.9	--
Xa - Xb	-2.56	+3.31	-0.18	--
Sd'	0.78	0.97	1.66	--
df	180	120	29	--
Computed t	3.28	3.41	0.11	--
Probability of larger t	40.001	<0.001	0.9-0.7	--

Table 34. The mean scale radius measurements (in mm at 81X magnification) at each annulus of cutthroat trout which spend 3 years in tributaries before entering the main river and were collected in the upper St. Joe River in 1975 versus 1969-1970, difference in radius measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli				
	I	II	III	IV	
Mean scale radius					
1975 (a)	7.18	15.73	30.32	48.33	66.46
1969-1970 (b)	11.55	20.23	34.45	52.41	61.68
Calculated total length (mm)					
1975	66.6	97.9	151.3	217.2	283.6
1969-1970	82.6	114.4	166.4	232.2	266.1
Xa - Xb	-4.37	-4.50	-4.13	-4.08	+4.78
Sd	0.20	0.35	0.55	1.34	3.26
df	209	372	372	136	45
Computed t	21.85	12.86	7.51	1.87	1.47
Probability of larger t	<0.001	<0.001	<0.001	0.1-0.05	0.2-0.1

Table 35. The mean scale measurements (in mm at 81X magnification) between consecutive annuli of cutthroat trout which spend 3 years in tributaries before entering the main river and were collected in the upper St. Joe River in 1975 versus 1969-1970, difference in increment measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli			
	I to II	II to III	III to IV	IV to V
Mean scale increment				
1975 (a)	9.45	14.57	18.86	17.30
1969-1970 (b)	11.95	13.68	17.38	14.26
Increment of growth (mm)				
1975	34.6	53.3	69.0	63.3
1969-1970	43.7	50.1	63.6	52.2
Ka - Xb	-2.50	+0.89	+1.48	+3.04
d	0.39	0.39	0.84	1.40
f	210	373	131	44
imputed t	6.41	2.28	1.76	2.17
Probability of larger t	<0.001	0.05-0.02	0.1-0.05	0.05-0.02

Table 36. The mean scale measurements (in mm at 81X magnification) between consecutive annuli of Kelly Creek cutthroat trout collected in 1975 versus 1969-1970, difference in increment measurements, calculated t values, and probability of getting a larger t value by chance alone.

	Annuli			
	I to II	II to III	III to IV	IV to V
Mean scale increment				
1975 (a)	10.89	15.28	19.05	14.38
1969-1970 (b)	10.71	12.55	15.41	12.60
Increment of growth (mm)				
1975	39.0	54.7	68.2	51.4
1969-1970	38.3	44.9	55.2	45.1
Xa - Xb	+0.18	+2.73	+3.64	+1.78
Sd	0.32	0.41	0.84	1.55
df	333	397	147	28
Computed t	0.56	6.72	4.32	1.15
Probability of larger t	0.7-0.5	<0.001	<0.001	0.3-0.2

annuli IV and V compared to Trib 3 cutthroat collected in 1969-1970 (Table 35). As a result of increased growth rates between annuli II and IV, cutthroat collected from the St. Joe River in 1975 and 1969-1970 were the same lengths at age III and/or IV (Tables 32 and 34).

Growth of Tagged Cutthroat Trout

In the Kelly Creek-North Fork study area, the mean yearly increase in length for tagged cutthroat in the main river systems was 63 mm. The mean yearly increase was 27 mm for tagged cutthroat in smaller tributaries and 49 mm in larger tributaries (Moose Creek and Cayuse Creek) for the years 1970 and 1975 (Table 37). Tagged cutthroat we recaptured from the upper St. Joe River had grown an average of 38 mm per year. Two cutthroat trout measuring about 190 mm when tagged in 1970 were "keepers" (longer than 330 mm) when recaptured in 1974 (Table 37).

Monet-metal mandible tags did not appear to affect growth of cutthroat trout in Kelly Creek or the North Fork of the Clearwater River, but slowed growth of cutthroat in the upper St. Joe River. This inconsistency cannot be readily explained as we used only those cutthroat which were recaptured and/or measured by project personnel to determine growth of tagged cutthroat. Irving (1953) and Youngs (1958) stated that jaw tags had no effect on growth of salmonids. Jaw tags retarded growth of salmonids in other studies (Pechacek 1956, DeRoche 1963, Shetter 1967, Stauffer and Hanson 1969, Warner 1971).

Maturity

Kelly Creek

Most male and female cutthroat trout in Kelly Creek matured after six years of life (age-class VI). No cutthroat spawned before age VI. Only 1

Table 37. Growth of cutthroat tagged and recaptured in the Kelly Creek-North Fork and St. Joe River study areas.

Location and tag year-recapture year	Number of fish	Mean number of days	Mean length (mm) Start	End	Mean increase (mm)	Mean increae peryear (mm)
Kelly Creek-North Fork						
Main river						
1970-1971	3	359	200.7	277.0	76.3	77.6
1971-1972	7	365	213.3	276.7	63.3	63.3
1972-1973	8	358	213.1	298.4	85.2	86.9
1973-1974	10	353	244.0	291.9	47.9	49.5
1974-1975	3	353	206.7	284.3	78.0	80.6
1971-1973	6	708	189.0	394.4	104.3	53.8
1972-1974	3	730	235.7	315.7	80.0	40.0
1973-1975	1	760	286.0	364.0	78.0	37.5
					Weighted grand =	63.1
Tributaries						
Barnard Creek						
1974-1971 1971-1972	3	362	183.3	218.3	25.8	26.0
Pete Ott Creek						
1970-1971 1971-1972	4	349	146.5	173.8	27.2	28.4
Elizabeth Creek						
1971-1972	3	373	148.7	180.3	31.7	31.0
Osier Creek						
1972-1974	1	730	284.0	315.0	31.0	15.5
				Weighted grand mean =		27.3
Moose Creek						
1973-1974	1	367	235.0	297.0	62.0	61.7
1973-1975	1	789	214.0	315.0	101.0	46.7
Cayuse Creek						
1972-1974	1	730	248.0	322.0	74.0	37.0
				Weighted grand mean =		48.5
St. Joe River						
Main river						
1973-1974	2	375	206.0	251.0	44.5	43.3
1974-1975	8	359	230.0	266.0	36.8	37.4
1973-1975	3	722	222.0	292.0	69.3	35.0
1970-1974	2	1514	189.0	363.0	174.5	42.1
				Weighted grand mean =		38.3

of 24 males examined, which were less than 300 mm in length, had matured, but 14 of the 18 males longer than 300 mm had matured (Table 38). Five of 52 females inspected, which were less than 310 mm in length, had matured, but all of the 20 females over 311 mm had matured (Table 38). The sex ratio of cutthroat longer than 215 mm in our sample was 1 male:1.79 females.

Table 38. Maturity of cutthroat trout collected from Kelly Creek in September and October, 1975, as assessed by gonadal inspection.

	Total length (mm)	Number inspected	Number mature	Percent mature
Males	215-285	17	0	0
	286-299	6	1	17
	300-314	9	5	56
	315+	9	9	100
Females	215-291	41	0	0
	292-310	11	5	45
	311+	20	20	100

Six of seven male rainbow trout 203-219 mm in length examined from Kelly Creek, and all 13 males longer than 220 mm were classified as mature (would spawn the next spring). None of the 11 female rainbow trout inspected which ranged from 172-219 mm had matured, but one fish longer than 220 mm had reached maturity (Table 39). The sex ratio of rainbow trout longer than 172 mm in our sample was 1.67 males:1 female.

Table 39. Maturity of rainbow trout collected from Kelly Creek in September and October, 1975, as assessed by gonadal inspection.

	Total length (mm)	Number inspected	Number mature	Percent mature
Males	203-219	7	6	86
	220+	13	13	100
Females	172-219	11	0	0
	220+	1	1	100

St. Joe River

Most male and female cutthroat in the upper St. Joe River matured at age-classes IV and V, respectively. None of 32 males we examined, which ranged from 147-176 mm in length, had matured, but half of the males from 177-212 nun and all fish longer than 212 mm had reached maturity (Table 40). None of the 20 females less than 174 mm had matured, but one-fourth to half of the females in the 174-262 **nun** length range and all fish longer than 262 nun had reached maturity (Table 40). The sex ratio of cutthroat longer than 141 nun in our sample was 1 male:1.03 females.

Age Structure and Mortality of Cutthroat Po[p]ulations

Kelly Creek

The annual mortality rate for age III and older cutthroat trout in Kelly Creek (Kelly Forks to Moose Creek) declined as a result of catch-and-release regulations. Estimates of the total annual mortality rate for age III and older cutthroat were 0.63 and 0.82 in 1969 and 1970, respectively But declined to 0.48 in 1975 (Table 41). The estimate of the annual mortality

Table 40. Maturity of cutthroat trout collected from the upper St. Joe River in late summer, 1969 and 1970 (Rankel 1971), and September, 1975, as assessed by gonadal inspection.

	Total length (mm)	Number inspected	Number mature	Percent mature
^Males	147-176	32	0	0
	177-194	16	8	50
	195-212	18	11	61
	212+	33	33	100
Females	141-173	20	0	0
	174-196	18	4	22
	197-218	20	5	25
	219-240	22	9	41
	241-262	14	8	57
	262+	12	12	100

Table 41. Age compositions, instantaneous mortality rates, annual survival rates, and annual **mortality** rates of cutthroat trout in Kelly Creek from 1969 to 1975.

Year	Age class I	II	III	IV	V	VI	Instantaneous mortality rate (Z)	Annual survival rate (S)	Annual mortality rate (A) All of Kelly Creek	Annual mortality rate (A) Roaded section of Kelly Creek
1969	0	3 (4)[1]	50 (59)	28 (33)	3 (4)	0	0.99	0.37		0.63
1970	0	23 (19)	63 (51)	33 (27)	4 (3)	0	1.74	0.18		0.82
1971[2]	0	21 (17)	67 (52)	30 (23)	7 (5)	4 (3)	0.93	0.40	0.60	
1972[2]	0	8 (4)	88 (50)	41 (23)	30 (17)	10 (6)	0.67	0.51	0.49	
1973[2]	0	6 (4)	76 (46)	40 (24)	26 (15)	19 (11)	0.48	0.62	0.38	
1974	0	8 (3)	105 (42)	74 (30)	39 (16)	23 (9)	0.49	0.61	0.39	0.46
1975	0	12 (4)	115 (41)	84 (30)	44 (16)	27 (9)	0.37	0.69	0.31	0.48

[1]First value represents number of fish; value in parentheses equals the corresponding percentage.
[2]1971, 1972, and 1973 age-frequencies were converted from length-frequencies in Hogander, et al. (1974).

rate for age III and older cutthroat in the entire Kelly Creek study area was less than 0.40 in 1973, 1974, and 1975 (Table 41). Catch-and-release regulations reduced the annual mortality rate of cutthroat during their fourth, fifth, and sixth years of life (Table 42). For example, the ratio of ages III:IV:V:VI in our collections was 100:56:6:0 in 1970, and 100:73:55:34 in 1975. The decline in annual mortality rates left more cutthroat to spawn at age VI.

Table 42. Annual mortality rates between consecutive age groups of cutthroat trout collected in Kelly Creek from 1969 to 1975.

Year	Age groups		
	III-IV	IV-V	V-VI
1969	0.44	0.89	1/
1970	0.80	0.88	1/
1971	0.55	0.77	0.43
1972	0.53	0.27	0.69
1973	0.47	0.35	0.27
1974	0.30	0.47	0.41
975	0.27	0.24	0.38

1/ No age VI cutthroat collected.

We could not compute an annual mortality rate for cutthroat collected sections of Kelly Creek with access by trail as we captured more cutthroat ages V and VI in these sections than of age IV. Cutthroat spawning in Der tributaries and/or those which migrate into cooler waters of the upper [a]ches of Kelly Creek during the summer may be the reason for the dispropormate number of older fish.

St. Joe River

The annual mortality rate for age III and older cutthroat trout in the upper St. Joe River declined as a result of trophy-fish angling regulations. Estimates of the annual mortality rates were 0.62 in 1969 and 0.71 in 1970, prior to initiation of the trophy-fish regulations, but 0.47 in 1972 and 0.56 in 1975 (Table 43). With trophy-fish regulations, the annual mortality rate for cutthroat declined between ages III and IV, and IV and V, but increased slightly between ages V and VI (Table 44). For example, the ratio of ages III:IV:V:VI in our collections was 100:35:9:1 in 1970, and 100:70:34:3 in 1975. As a result of reduced annual mortality rates, more cutthroat survived to spawn at ages IV, V, and VI.

Type of access to the upper St. Joe River affected mortality rates of the cutthroat population. In all years, cutthroat trout had higher mortality rates in the section of the river with access by road than in the section with access by trail (Table 43).

Angler Use, Catch, and Opinions

Kelly Creek-North Fork

Angler Effort: Fewer anglers fished Kelly Creek and the North Fork after catch-and-release regulations were put into effect. Anglers fished Kelly Creek an estimated 1640 hours (96.5 hours/km) in 1969 compared to hours (3.2 hours/km) in 1970, the first year of catch-and-release regulations. Angler effort on Kelly Creek increased to 297 hours (17.5 hours/km) by 1970 about one-fifth as many hours as in 1969 (Table 45). On the North Fork, angler effort decreased initially from 1149 hours (66.4 hours/km) in i969 to 960 hours (55.5 hours/km) in 1970. In 1975, anglers fished an estimated

Table 45. Hours fished, catch per hour, cutthroat trout per hour, and numbers and percentages of fish in the catch of anglers fishing Kelly Creek, 1969-1973 and 1975.

	Kelly Creek						
	1969	1970	1971	1972	1973	1975	1975
Anglers counted	348	15	73	82	96	65	--
Hours fished	1640[a]	54[a]	334[b]	375[b]	439[b]	297[a]	1210[c]
Catch per hour (includes releases)	3.4	6.1	2.7	3.1	1.8	1.9	1.9
Cutthroat per hour (includes releases)	0.2	0.4	0.8	1.3	1.1	1.3	1.3
Species composition of catch							
Rainbow-steelhead	92.7%	93.2%	72.2%	58.5%	39.5%	30.5%	30.5%
Cutthroat trout	6.1	6.0	27.5	40.3	55.9	66.3	66.3
Mountain	1.0	0.8	--	0.9	4.6	1.4	1.4
Dolly Varden	0.2	--	0.3	--	--	0.7	0.7
CT x RB hybrid	--	--	--	--	--	1.1	1.1
Angler catch (numbers)							
Rainbow-steelhead	5169[d]	307[d]	651[d]	680[d]	312[d]	172[d]	616[e]
Cutthroat trout	328	22	267	487	483	386	155
Mountain whitefish	56	3	--	10	36	8	33
Dolly Varden	11	--	3	--	--	4	16
CT x RB hybrid	--	--	--	--	--	6	26

[$]Hours fished computed as in Ball (1971).
[b]Computed from ratio of anglers counted in 1975::hours fished in 1975 and applied to anglers counted in 1971-1973 to obtain hours fished.
[=]Hours fished computed from stratified random creel census.
[A]Angler catch = (angler effort) x (catch per hour) x (species composition).
['']Angler catch computed from stratified random creel census.

630 hours (36.0 hours/km) on the North Fork, 55% of the effort expended in 1969 (Table 46).

The initial decline in angler effort on Kelly Creek was due in part to a hesitancy by anglers to try catch-and-release regulations. The close proximity of the North Fork to Kelly Creek was probably responsible for the initial decline in effort on the North Fork as anglers commonly fished both streams in 1969 (Ball 1971). The number of anglers reached a low on the North Fork in 1972, partly because of road closures by avalanches and partly as a result of the reduction of the bag limit to 3 fish from 15 fish.

Angler Catch: On Kelly Creek, the number of cutthroat caught by anglers in 1969 and 1975 was about the same, but angler harvest of cutthroat decreased. On the North Fork, angler catch of cutthroat and number of cutthroat harvested by anglers were about the same in 1969 and 1975.

Using similar census methods in 1975 as in 1969, we estimated that anglers fishing Kelly Creek caught 386 cutthroat in 1975 compared to 328 cutthroat in 1969 (Table 45). Anglers kept (harvested) virtually all cutthroat caught in 1969, but released all cutthroat caught in 1975. Anglers caught and kept 5169 juvenile rainbow-steelhead from Kelly Creek in 1969 while, in 1975, anglers caught and released 172 rainbow-steelhead. Total catch on Kelly Creek by anglers declined from 5508 trout in 1969 to 568 trout in 1975 (Table 45). The decline in total catch was primarily a result of reduced abundance of rainbow-steelhead in the stream and reduction in angler effort.

While fishing the North Fork, anglers caught an estimated 126 cutthroat in 1975 compared to 115 cutthroat in 1969 (Table 46). Anglers kept (harvested) virtually all cutthroat caught in 1969, but kept only 55% of the

Table 46. Hours fished, catch per hour, cutthroat per hour, and numbers and percentages of fish in the catch of anglers fishing the North Fork of the Clearwater River, 1969-1973 and 1975.

	North Fork						
	1969	1970	1971	1972	1973	1975	1975
Anglers counted	233	208	176	70	167	122	--
Hours fished	1149[a]	960[a]	908[b]	361[b]	862[b]	630[a]	2404[c]
Catch per hour (includes releases)	2.4	2.7	1.9	1.2	0.6	0.8	0.8
Cutthroat per hour (includes releases)	0.1	0.2	0.3	0.5	0.2	0.2	0.2
Species composition of catch							
Rainbow-steelhead	92.3%	89.4%	71.4%	45.5%	30.0%	*49.57.*	49.5%
Cutthroat trout	3.4	7.0	14.4	42.5	28.2	20.7	20.7
Mountain whitefish	2.0	2.8	6.4	4.4	25.3	15.8	15.8
Dolly Varden	2.3	1.8	0.7	7.4	9.7	14.0	14.0
Kokanee		--	--	--	6.8	--	
Angler catch (numbers)							
Rainbow-steelhead	2545[d]	2317[d]	1231[d]	197[d]	155[d]	249[d]	914[e]
Cutthroat trout	115	192	272	180	172	126	413
Mountain whitefish	55	73	110	19	131	80	308
Dolly Varden	64	47	12	32	50	71	459
Kokanee	--	--	--	--	35	--	--

[a]Hours fished computed as in Ball (1971).
[b]Computed from ratio of anglers counted in 1975::hours fished in 1975 and applied to anglers counted in 1971-1973 to obtain hours fished.
[c]Hours fished computed from stratified random creel census.
[d]Angler catch = (angler effort) x (catch per hour) x (species composition).
[e]Angler catch computed from stratified random creel census.

cutthroat caught in 1975. Anglers caught an estimated 71 Dolly Varden in 1975 compared to 64 Dolly Varden in 1969. Anglers kept 80% of the Dolly Varden caught in 1975. Anglers caught an estimated 249 rainbow-steelhead in 1975 compared to 2545 juvenile steelhead in 1969. Anglers kept 52% of the rainbow-steelhead caught in 1975. Total catch by anglers on the North Fork declined from 2724 trout in 1969 to 446 trout in 1975 (Table 46). The decline in total catch was primarily a result of reduced abundance of rainbow-steelhead in the stream and reduced angler effort.

Since anglers released a large proportion of the trout caught, it appears that catch-and-release angling was practiced to a degree on the North Fork in 1975. It is interesting to note that 43.97. of the anglers interviewed while fishing Kelly Creek in 1975 also fished the North Fork in 1975 and may have "fished-for-fun" on the North Fork to a degree as well. By fishing both streams, some anglers took advantage of the diversity of angling: opportunities present in the area.

Angler Catch Rates: While abundance of rainbow-steelhead declined in both streams, angler catch rate for cutthroat trout increased on Kelly Creek but remained unchanged on the North Fork. In Kelly Creek, angler catch rats of cutthroat trout increased from 0.2 cutthroat/hour in 1969 to 1.3 cutthroat hour in 1975 (Table 45). On the North Fork, the catch rate was 0.1 cutthroat hour in 1969 and 0.2 cutthroat/hour in 1975 (Table 46). The percentage of cutthroat in the catch increased with a decline in abundance of rainbow-steelhead present in the two streams (Tables 45 and 46), and is partially responsible for the change in angler catch rates of cutthroat.

Angler Profile: The population of anglers fishing Kelly Creek and their behavior changed after catch-and-release regulations were initiated in 19700. Prior to 1970, most anglers fished with bait on Kelly Creek (Table

With bait prohibited on Kelly Creek in 1970, more anglers initially ;e lures than flies as an alternative fishing method. In 1975, more

ers fishing Kelly Creek used flies than lures. On Kelly Creek, a larger mntage of anglers interviewed were in the 14-29 year age group, males,

ion-residents in 1975 than in 1969 (Table 47). Mean size of angler party

_udes non-fishermen) was smaller in 1975 than in 1969, suggesting reduced

y participation in angling on Kelly Creek. In all years, most fishermen

Ily Creek preferred to catch a few large fish rather than many small (Table 47).

Most of the characteristics of anglers fishing the North Fork have ranged since 1969. A larger percentage were non-resident anglers in

han in 1969, with California anglers accounting for most of the increase. ize of angler party (includes non-fishermen) was smaller in 1975 than 9 (Table 48).

Angler Opinion Survey: More than 90% of the anglers interviewed while Kelly Creek in 1975 were in favor of the catch-and-release reguland thought that fishing was better in 1975 than before the special ions were initiated. Most anglers rated fishing as good, preferred h native cutthroat trout while fishing Kelly Creek, preferred to re-11 fish caught rather than being able to keep a few large fish, and a "trophy" cutthroat trout in Kelly Creek as 14 inches in length or

Table 47. Mean size of party, angling method, sex, age, and residence of anglers fishing Kelly Creek, 1969 to 1973 and 1975.

	Kelly Creek					
	1969	1970	1971	1972	1973	197
Number fishermen sampled	498	56	73	82	96	60
Mean size of party	3.29	2.86	1.67	3.88	3.60	1.6
Bait fishermen (7.)	55.6	10.7[a]	3.2[a]	--		
Fly fishermen (7.)	29.8	41.1	60.3	80.5	86.	71.2
Lure fishermen (%)	14.6	48.2	36.5	19.5	14.0	28.8
Using barbless hooks (7.)						93.0
Male (7.)	74.2	80.0				84.7
Female (%)	25.8	20.0				15.3
Age (Male (%)/Female (7.))						
Less than 14	14.6/16.9	8.7/11.2				2.0/33.3
14 to 29	19.9/10.5	45.7/33.3			--	48.0/33.
38 to 44	29.8/21.8	19.6/22.2			--	+
45 to 59	27.5/37.9	23.9/33.3			--	34.0/33
60+	8.2/12.9	2.1/0.0				.4
						14.0/0.0
Resident anglers (7.)						
Clearwater County	31.7	20.3				27.9
Nez Perce County	30.6	7.4				27.9
Latah County	11.6	20.4				
Idaho County	**6.6**					
Shoshone County	1.4	12.9				3.3
Other	3.4	7.5				
Total	85.3	68.5				59.1
Non-resident anglers (%)						
Washington	9.5	11.1				24.6
Montana	1.8	1.9			--	1.6
Oregon	1.2	3.7				
California	0.4	14.8				8.2
Other	1.8					6.5
Total	14.7	31.5				40.9
Preferred few large (7.)	58.9	82.0	65.0	87.9	76.0	62.0
Preferred many small (7.)	41.1	18.0	30.0	7.3	4.0	
No preference (7)			5.0	4.8	20.0	38.0

[a]lllegal.

Table 48. Mean size of party, angling method, sex, age, and residence of anglers fishing the North Fork of the Clearwater River, 1969 to 1973 and 1975.

	North Fork					
	1969	**1970**	**1971**	1972	1973	1975
Number fishermen sampled	407	351	**176**	70	167	150
Mean size of party	3.38	3.98	1.50	3.46	3.90	2.30
Bait fishermen (%)	54.4	48.4	44.3	28.5	31.8	46.3
Fly fishermen (7.)	22.6	22.5	29.5	48.5	34.6	24.7
Lure fishermen (%)	23.0	29.1	26.2	22.8	33.6	29.0
Male (%)	77.1	80.4				78.9
Female (7.)	22.9	19.6				21.1
Age (Male (7.)/Female (%))						
Less than 14	15.4/14.3	19.1/8.7			--	23.6/8.7
15 to 29	23.2/15.3	18.0/17.4			--	16.9/30.4
30 to 44	27.1/23.1	23.3/24.6			--	30.3/39.2
45 to 59	25.2/34.1	29.0/36.2			--	23.6/17.4
60+	9.2/13.2	10.6/13.1			--	5.6/4.3
Resident anglers (%)						
Clearwater County	25.1	27.4				40.0
Nez Perce County	46.0	41.6				17.4
Latah County	6.8	3.9				1.7
Idaho County	1.2	3.8				0.0
Shoshone County	2.7	5.0				5.2
Other	7.4	3.5	[11]			4.4
Total	89.2	85.2				68.7
Non-resident anglers (7.)						
Washington	8.1	8.6				8.7
Montana	0.3	0.9				3.5
Oregon	1.2	0.9				0.0
California	1.2	2.3				15.6
Other	0.0	1.8				3.5
Total	10.8	14.5				31.3
Preferred few large (7.)	61.9	58.9	34.0	81.5	54.0	62.2
Preferred many small (%)	38.1	41.1	31.0	10.0	24.0	24.2
No preference (%)			35.0	8.5	22.0	13.6

Of the anglers interviewed while fishing the North Fork in 1975, 94% were in favor of the catch-and-release regulations in effect on Kelly Creek. Most anglers rated fishing on the North Fork as fair, preferred to catch native cutthroat trout while fishing the North Fork, preferred to keep a few large fish rather than releasing all fish caught, defined a "trophy" cutthroat in the North Fork as 14 inches in length or longer, and believed quality of angling on the North Fork had declined in recent years.

Specific questions we posed to anglers in 1975 and their responses (as percentage of anglers in sample) are listed on the following pages.

1. Question: Would you rate the fishing on Kelly Creek/North Fork/St. Joe River as good, fair, or poor?

	Area fished when interviewed			
	Kelly Creek	North Fork	St. Joe River	
Response:	Special regulations	Standard regulations	Standard regulations	Special regulations
Good	48.8%	28.6%	42.8%	74.2%
Fair	34.1	51.8	25.0	12.9
Poor	17.1	19.6	32.2	12.9
Anglers responding	41	56	28	62

2. Question: In terms of length of fish, how would you define a "trophy" cutthroat trout in Kelly Creek/North Fork/St. Joe River?

	Area fished when interviewed			
	Kelly Creek	North Fork	St. Jo River	
Response:	Special regulations	Standard regulations	Standard regulations	Special regulations
Longer than 12"	22.2%	19.2%	2.9%	1.6%
13"	5.6	3.8	14.7	4.7
14"	72.2	76.9	82.4	93.8
Anglers responding	36	52	34	64

3. Question: Have you fished Kelly Creek/North Fork/upper St. Joe River before 1970 (in the late 1960's)? If yes, would you say that the fishing is better now, better before, or about the same? If not the same, why?

	Area fished interviewe			
	Kelly Creek	North Fork	St. Joe River	
Response:	Special regulations	Standard regulations	Standard regulations	Special regulations
Yes	22.9%	78.1%	83.3%	78.0%
No	77.1	21.9	16.7	22.0
Anglers responding	5	59	36	61

Question 3. Continued.

	Area fished when interviewed			
	Kelly Creek	North Fork	St. Joe River	
Response: Continued regulations	Special	Standard regulations	Standard regulations	Special regulations
Better now	94.17%	8.0%	52.9%	72.7%
More fish	58.4	--	66.7	62.5
Larger fish	37.5	--	11.1	12.5
Special regulations			11.1	25.0
Fewer people	4.1	100.0		--
Other	--	--	7.1	--
Anglers responding	16	2	9	16
Better before	0.0%	68.0%	35.3%	18.2%
More fish	--	69.5	33.3	25.0
Larger fish	--	13.0	--	--
Fewer people	--	17.5	66.7	75.0
Anglers responding	--	17	6	4
Same	5.97%	24.0%	8.4%	37.5%
Anglers responding	1	6	2	2

Most anglers fishing Kelly Creek in 1975 had not fished Kelly Creek before 1970 when standard regulations were in effect. Most anglers who had fished Kelly Creek before 1970 thought that fishing was better in 1975. Most of the anglers fishing the North Fork in 1975 had fished the North Fork in the late 1960's and thought that the quality of angling had declined on the North Fork in recent years. Most anglers fishing the upper St. Joe River in 1975 had fished the upper St. Joe River in the late 1960's and thought that fishing was better in 1975, especially in the special regulations area (up" stream from Prospector Creek).

Crowded conditions appear to detract from an angler's fishing experience on the three streams. All anglers on the North Fork who thought fishing was better in 1975 thought so because there were fewer people fishing in

75. About 70% of the anglers on the upper St. Joe River who thought fishing was better in the late 1960's than in 1975 thought so because there were fewer people fishing in the late 1960's.

Question: In Kelly Creek in the Clearwater National Forest, all fish caught must be released. Under this regulation, cutthroat reach a size of up to 17" or longer and each large fish can be caught and released by more than one angler. In the upper St. Joe River in the St. Joe National Forest, a 13" minimum size limit was established to allow the cutthroat to spawn once before being harvested by anglers. Few of the cutthroat in the upper St. Joe River reach a size of 14" before being harvested and most fish larger than 13" are kept by the first angler to catch them.

Assuming both regulations would allow the cutthroat populations to thrive, would you rather fish a stream where you could catch and keep a 13" or 14" fish, or fish a stream where the fish get up to 17" or larger but all fish must be released?

	Area fished when interviewed			
	Kelly Creek	North Fork	St. Joe River	
Response:	Special regulations	Standard regulations	Standard regulations	Special regulations
Keep a few large	15.8%	50.0%	58.3%	71.7%
Release all	84.2	16.7	22.2	21.7
Other	-	33.3	19.5	6.6
Anglers responding	38	54	36	60

Most anglers on the three study streams preferred to fish a stream with regulations similar to those in effect on the stream they were fishing. More than 20% of the anglers fishing the upper St. Joe River preferred

released some cutthroat 13 inches in length or longer. About one-sixth (17%) of the anglers fishing the North Fork preferred to fish a stream having catch-and-release regulations. These anglers probably came to the study area to fish Kelly Creek, but fished the North Fork as well and thus took advantage of the diversity of angling opportunities available in the area.

5. Question: Do you prefer to catch cutthroat trout or rainbow trout when fishing Kelly Creek/North Fork/St. Joe River?

	Area fished when interviewed			
	Kelly Creek	North Fork	St. Joe River	
Response:	Special regulations	Standard regulations	Standard regulations	Special regulation
Cutthroat	100.07.	91.37.	97.1%	96.7%
Rainbow	--	2.2	2.9	1.6
Either	--	6.5		1.7
Anglers responding	40	46	34	61

Most anglers on all three study streams preferred to catch native cutthroat trout. More anglers preferred to catch cutthroat in the upper St. Joe River in 1975 than in 1969 and 1970. In 1969-1970, of 223 respondents above Avery, 57% preferred to catch cutthroat trout rather than hatchery-reared rainbow trout (Rankel 1971).

6. Question: On Kelly Creek and the North Fork we asked: There are presently special regulations in effect on Kelly Creek and the tributaries to Kelly Creek which say that all fish caught must be released. In this area, no hatchery rainbow trout are stocked, fishing with bait is prohibited, and single barbless hooks are required. Are you in favor or opposed to the special regulations? If opposed, why?

Question 6. Continued.

Response:	Area fished when interviewed: Kelly Creek — Special regulations	North Fork — Standard regulations
Favor	93.0%	94.0%
Oppose	7.0	6.0
Anglers responding	43	50

More than 90% of the anglers interviewed while fishing in the Kelly Creek-North Fork study area in 1975 favored the catch-and-release regulations in effect on Kelly Creek. Anglers on the North Fork who were opposed to the special regulations liked to fish with bait and/or keep a few fish. The Kelly Creek anglers who "opposed" catch-and-release regulations thought Kelly Creek should be restricted further with a "flies-only" regulation.

On the upper St. Joe River we asked: There are presently special regulations in effect on the upper St. Joe River starting at Prospector Creek, 11 miles above Avery, which say that an angler may keep 3 trout per day provided each trout is 13" in length or longer. In this area, no hatchery rainbow trout are stocked and fishing with bait is prohibited. Are you in favor of or opposed to the special regulations?

Response:	Standard regulations	Special regulations
Favor	97.0%	96.8%
Oppose	3.0	3.2
Anglers responding	33	62

More than 90% of the anglers interviewed while fishing the upper St.

to the special regulations thought a "flies-only" restriction should be added.

7. Question: If allowing you to keep one fish of any size per day on Kelly Creek/St. Joe River meant that the native cutthroat trout population would be maintained and that you would probably catch one fish each day, but that in the long run there would be fewer fish than there are now, that your fishing catch rates would be reduced, and that the general overall size of the fish would be smaller, would you favor or oppose a regulation allowing you to keep one fish of any size per day?

	Area fished when interviewed			
	Kelly Creek	North Fork	St. Joe River	
Response:	Special regulations	Standard regulations	Standard regulations	Special regulation.
Favor	16.77.	40.07.	5.7%	3.2%
Oppose	83.3	60.0	94.3	96.8
Anglers responding	36	45	35	62

Most anglers on all three streams opposed changing the special regulations to allow anglers to keep one fish of any size per day. However, 40% of the anglers interviewed while fishing the North Fork in 1975 favored liberalizing the catch-and-release regulations on Kelly Creek.

8. Question: Do you think that the special regulations should be extended to the North Fork of the Clearwater River/further down the St. Joe River? If yes, to what area?

Question 8. Continued.

	Area fished when interviewed			
	Kelly Creek	North Fork	St. Joe River	
Response:	Special regulations	Standard regulations	Standard regulations	Special regulations
Yes	12.9%	7.7%	40.6%	54.9%
No	87.1	92.3	59.4	45.1
Anglers responding	31	52	32	51

About 90% of the anglers in the Kelly Creek-North Fork study area were opposed to an extension of the special regulations area. Anglers in favor thought catch-and-release regulations should be extended to the North Fork upstream from Kelly Forks or to Bungalow, 19 miles downstream from Kelly Forks.

On the upper St. Joe River, most anglers fishing in the special regulation area favored an extension of the special regulations area while most anglers fishing in the standard regulations area opposed an extension. Most of the anglers in favor thought the trophy-fish regulations should be extended to Avery, and some thought as far downstream as Marble Creek (12 miles downstream from Avery) or Calder (22 miles downstream from Avery).

9. Question: Studies done in Idaho and other states have revealed no differences in the number of mortalities to fish by anglers whether barbed or barbless hooks are used. Do you think that barbless hooks should be required on Kelly Creek/St. Joe River wherever the special regulations are in effect?

Question 9. Continued.

Response:	Area fished when interviewed: Kelly Creek Special regulations	North Fork Standard regulations	St. Joe Standard regulations	River Special regulations
Yes	48.5%	22.0%	37.9%	25.0%
No	51.5	78.0	62.1	75.0
Anglers responding	33	50	29	56

Most anglers on all three study streams did not think barbless hooks should be required in conjunction with special regulations. On Kelly Creek, 93% of the anglers used barbless hooks as required (Table 47), but only about half thought that barbless hooks should be required.

Volunteer Creel Census and Opinion Survey: In 1975 we conducted a volunteer creel census and angler opinion survey in sections of Kelly Creek and the North Fork with access by trail. No anglers answered questionnaires on the North Fork. Of the anglers answering questionnaires on Kelly Creek (n = 12), most were male, between 15 and 25 years of age, fished with flies, were residents of Idaho or Washington, and planned to fish 3 to 6 days on Kelly Creek in 1975. All of these anglers were in favor of the special regulations and used barbless hooks as required. Most anglers had not fished Kelly Creek in previous years, rated fishing as good, preferred to catch native cutthroat trout, and defined a "trophy" cutthroat in Kelly Creek as 16 inches in length or longer. Most anglers in this section of river thought special regulations should be extended to the North Fork of the Clearwater River upstream from Kelly Forks and that barbless hooks should be required wherever special regulations are in effect. All anglers were opposed to changing the regulations to allow anglers to keep one fish of any size per day.

St. Joe River

Angler Effort: The number of anglers fishing the upper St. Joe River declined in 1971 when trophy-fish regulations were put into effect, but angler effort increased subsequently. The effect of special regulations is best illustrated by the data we have on the Gold Creek to Spruce Tree Camp section of the upper St. Joe River. Census boundaries chosen for the 1968 =ensus do not allow us to present completely comparable data for the entire >ection of river under special regulations. In 1968, anglers fished 2216

Camp, but only 620 hours (33.0 hours/lan) in 1971. Anglers fished an estimated 1998 hours (106.3 hours/km) in this section in 1975 (Table 49). Angler effort in the entire census area (Avery to Spruce Tree Camp) declined from 9758 hours in 1968 to 5725 hours in 1971, but increased to 9832 hours in 1975 (Table 49).

Angler Catch: The number of cutthroat trout caught by anglers from the upper St. Joe River increased, but angler harvest decreased as a result of trophy-fish regulations. In the special regulations area, anglers caught about 8 times more cutthroat from Gold Creek to Spruce Tree Camp in 1975 than in 1968, but kept less than one-tenth the number they kept in 1968. Anglers caught 904 cutthroat in 1968 and kept virtually all of the fish; in 1975, anglers caught 7363 cutthroat trout but kept only 63 cutthroat from Gold Creek to Spruce Tree Camp (Table 49). In the entire census area (Avery to Spruce Tree Camp), anglers caught 5 times more cutthroat trout in 1975 than in 1968, but kept only about one-half the number they kept in 1968. Anglers caught 3173 cutthroat trout in 1968 and kept virtually all of the fish; in 1975, anglers caught 16,080 cutthroat trout but kept only 1430 cutthroat in the entire census area (Table 49).

In the special regulations area, percentage of cutthroat kept by anglers increased from 3.970 in 1972 to 5.4°h in 1973, but decreased to 1 . 5 % in 1975. The decline in proportion of legal cutthroat harvested by anglers, if real, may be the result of multiple recapture of sublegals, release of "keepers" by anglers, and/or increased abundance of sublegal cutthroat trout

Rainbow trout, which made up 50% of the total catch by anglers in

Table 49. Angler effort and angler catch in the upper St. Joe River in 1968, 1971 to 1973, and 1975.

River section	1968	1971	1972	1973	1975
Avery to Gold Creek					
Hours fished	7542	--	--	--	--
Fish caught and kept	5156	--	--	--	--
Cutthroat	2269	--	--	--	--
Rainbow	2836	--	--	--	--
Other	51	--	--	--	--
Avery to Prospector Creek					
Hours fished	--	4169	5538	4983	4485
Fish caught	--	6375	5865	2425	4718
Cutthroat	--				2744
Rainbow	--				1974
Other	--				
Fish kept	--	6375	5865	2425	2876
Cutthroat	--	1594	762	1050	1236
Rainbow	--	4654	5044	1278	1640
Other	--	127	59	97	0
Prospector Creek to Gold Creek					
Hours fished	--	936	3103	3110	3349
Fish caught	--		6068	10542	6181
Cutthroat	--	--	6007	9699	5973
Rainbow	--	--	<1%	738	208
Other	--	--	<1%	105	0
Fish kept	--	25	326	759	131
Cutthroat	--	0	326	660	131
Rainbow	--	25	0	23	0
Other	--	0	0	76	0
Gold Creek to Spruce Tree					
Hours fished	2216	620	1279	1969	1998
Fish caught	1808	--	3583	8095	7389
Cutthroat	904	--	3547	8014	7363
Rainbow	904	--	<1%	81	26
Other	--	--	<1%	0	0
Fish kept	1808	60	82	324	63
Cutthroat	904	30	82	324	63
Rainbow	904	0	0	0	0
Other	0	30	0	0	0
Total hours fished	9758	5725	9920	10062	9832
Total fish caught	6964	6460	15516	21062	18288
Total fish kept	6964	6460	6273	3500	3070

hatchery-reared rainbow trout all along the St. Joe River. In 1971, they discontinued stocking hatchery rainbow trout upstream from Prospector Creek. Rainbow trout caught in the special regulations area in 1975 were mostly fish which had moved upstream from releases made downstream from Prospector Creek.

Angler Catch Rates: In sections of river with special regulations and access by road, angler catch rate of cutthroat increased from 0.2 cutthroat/hour in 1968 to about 2.5 cutthroat/hour in 1975. Compared to 1968, the catch rate in 1975 was about 2.5 times faster from Prospector Creek to Gold Creek (access by paved road) and about 4.4 times faster from Gold Creek to Spruce Tree Camp (access by unpaved road) (Table 50). Anglers answering the volunteer creel census in 1975 caught 3.2 cutthroat/hour from Spruce Tree Camp to Ruby Creek (access by trail). Angler catch rates were highest in 1973, a year with reduced summer flows and a shortened season (Table 50).

In special regulations sections, catch rate of "keepers"/hour was about the same in 1971 (0.02 "keepers"/hour) and 1975 (0.04 "keepers"/hour). Some cutthroat longer than 13 inches were released by anglers in 1975 so the catch rate of "keepers" was a minimum.

Angler Profile: The population of anglers fishing the upper St. Joe River changed after trophy-fish regulations were initiated. From Avery to Gold Creek (access by paved road), we interviewed more non-resident anglers in 1975 (43.1%) than in 1968 (25.07.) (Table 51). With bait prohibited starting in 1971, more anglers fished with flies than lures as an alternative

Fished with bait from Avery To Prospector Creek

Table 50. Angler catch of cutthroat trout per hour during July and August the sections of the upper St. Joe River under the trophy-fish regulations includes fish released in 1972 to 1975).

Prospector Creek to Gold Creek **(access by paved road)**	Gold Creek to Spruce Tree Camp (access by unpaved road)	Spruce Tree Camp to Ruby Creek (access by trail)
0.2[1]	0.4[1]	--
2.0	2.8	--
3.4	4.8	--
2.1	4.4	6.7
1.7	3.6	3.2[3]
2.5	2.7	5.4

Avery to Gold Creek in 1968. The catch rate for 1968 is a minimum as anglers released fish which were not included as fish caught in that year.
ect personnel fishing during August only.
Volunteer Creel Census information.
ect personnel fishing only.

Table 51. Sex, age, residence, and angling method of anglers fishing the upper St. Joe River in 1968 (standard regulations) and 1975 (special regulations).

	Avery to Prospector Creek (N=143-147)	Avery to Gold Creek		Prospector Creek to Gold Creek (N=133-139)	Gold Creek to Spruce Tree Camp (N=75-76)	
	1975	1968a	1975	1975	1968a	1975
Male	90.5%	--	--	89.9%	--	97.
Female	9.5	--	--	10.1	--	2.6
Age						
10 to 20	7.57.	--	--	8.670	--	5.3
20 to 40	56.5	--	--	59.0	--	58.7
40+	36.0	--	--	32.4	--	36.0
Resident anglers						
Shoshone	13.87.	--	--	25.4%	--	50.T
Latah	24.8	--	--	10.9	--	6.7
Kootenai	5.5	--	--	8.0	--	16.0
Nez Perce County	2.8	--	--	2.2	--	5.3
Benewah	13.8	--	--	5.8	--	2.7
Clearwater County	0.7	--	--	0.0	--	
Total	61.4	75.0	56.9	52.2	70.0	81.3
Non-resident anglers						
Washington	24.1%	--	--	37.7%	--	14.7
California	6.9	--	--	2.9	--	1.3
Montana	0.0	--	--	2.2	--	1.3
Oregon	2.8	--	--	1.3	--	0.0
Other (6 states)	4.8	--	--	3.6	--	I.
	38.6	25.0	43.1	47.8	30.0	1s
Angling						
Bait	28.8%	7.07.	15.57.	1.4%1)	9.07.	8b.t
Flies	51.4	58.0	65.0	79.9	54.0	
Lures	19.8	35.0c	19.3	18.7	37.0c	13.^
Days plan to fish						10.
1 to 2	8.470	--	--	11.37.	--	
3 to 5	23.8			23.3		37.E
5 to 10	32.8			27.1		30.-
10+	35.0			38.3		

aFrom Dunn (1968).

Camp (access by unpaved road), we interviewed more anglers from Idaho .975 (81.3%) than in 1968 (70.0%), and more anglers fished with flies in - (86.8%) than in 1968 (54.0%) (Table 51).

In all sections of the St. Joe River in 1975, 90% or more of the _ers were male, 60% were between 20 and 40 years of age, and most anglers .ned to fish the St. Joe River 5 to 10 days or more in 1975 (Table 51). majority of anglers in each section were residents of Idaho, but we rviewed more non-residents in sections of river with access by paved

Most non-resident anglers in all sections were residents of Washington.

Angler Opinion Survey: A majority of anglers who fished the upper St. liver in 1975 favored the special regulations and thought fishing was =r in 1975 than before special regulations were initiated. Most anglers d fishing as good, preferred to catch native cutthroat trout while fish-the upper St. Joe River, preferred to be able to keep a few large fish ar than releasing all fish caught, and defined a "trophy" cutthroat in ,pper St. Joe River as 14 inches in length or longer.

Specific questions we posed to anglers fishing the St. Joe River and responses (as percentages of anglers in sample) are listed on pages

102.

Volunteer Creel Census and Opinion Survey: In 1975, we conducted a teer creel census and angler opinion survey in the section of the St. fiver with access by trail. Of the anglers answering questionnaires 16), most were male, between 20 and 25 years of age, fished with flies, residents of Washington, planned to fish 3 to 5 days on the upper St.

All anglers answering questionnaires were in favor of the special regulations. Most anglers rated fishing as good, preferred to catch native cutthroat, defined a "trophy" cutthroat in the upper St. Joe River as 13 inches in length or longer, and were opposed to changing the regulations to allow anglers to keep one fish of any size per day. Some anglers thought special regulations should be extended downstream to Avery and most thought barbless hooks were not necessary with special regulations.

DISCUSSION

By 1969, angler harvest had reduced the abundance of cutthroat trout in Kelly Creek and the upper St. Joe River and the number of mature cutthroat trout in each stream was probably insufficient to adequately seed available rearing areas. The Idaho Fish and Game Commission initiated catch-and-release and trophy-fish angling regulations to reduce angler-caused mortality, allow more cutthroat to mature, and to increase the abundance of cutthroat trout. Special regulations successfully reduced angler-caused mortality (Tables 41 and 43), allowed cutthroat to live longer, grow larger, and increase in abundance.

Changes in Cutthroat Trout Population Structure _____ Special Angling Regulations

In the upper St. Joe River, we counted four times more cutthroat of all sizes in the transects in 1975 (n = 878) compared to 1969-1970 (n = 214) (Fig. 17). The most abundant size groups in our samples in 1969-1970 and 1975 were fish 170-190 mm in length. Cutthroat smaller than 150 mm and cutthroat longer than 250 mm were more abundant in 1975 than in 1969-1970 (Fig. 7). The increased abundance of small (<150 mm) fish was evidence of in--eased recruitment to the population and fishery. The increased abundance large 0.250 mm) cutthroat was evidence that many small fish caught and leased by anglers survived and became available to anglers at a larger size. n times more spawner-sized cutthroat 0.281 mm) were present in our samples 1975 (n = 144) than in 1969-1970 (n = 14), evidence that trophy-fish regutions increased the spawning stock. Our samples contained 15 cutthroat

lger than the minimum size limit of 13 inches (330 mm) in 1975 compared to

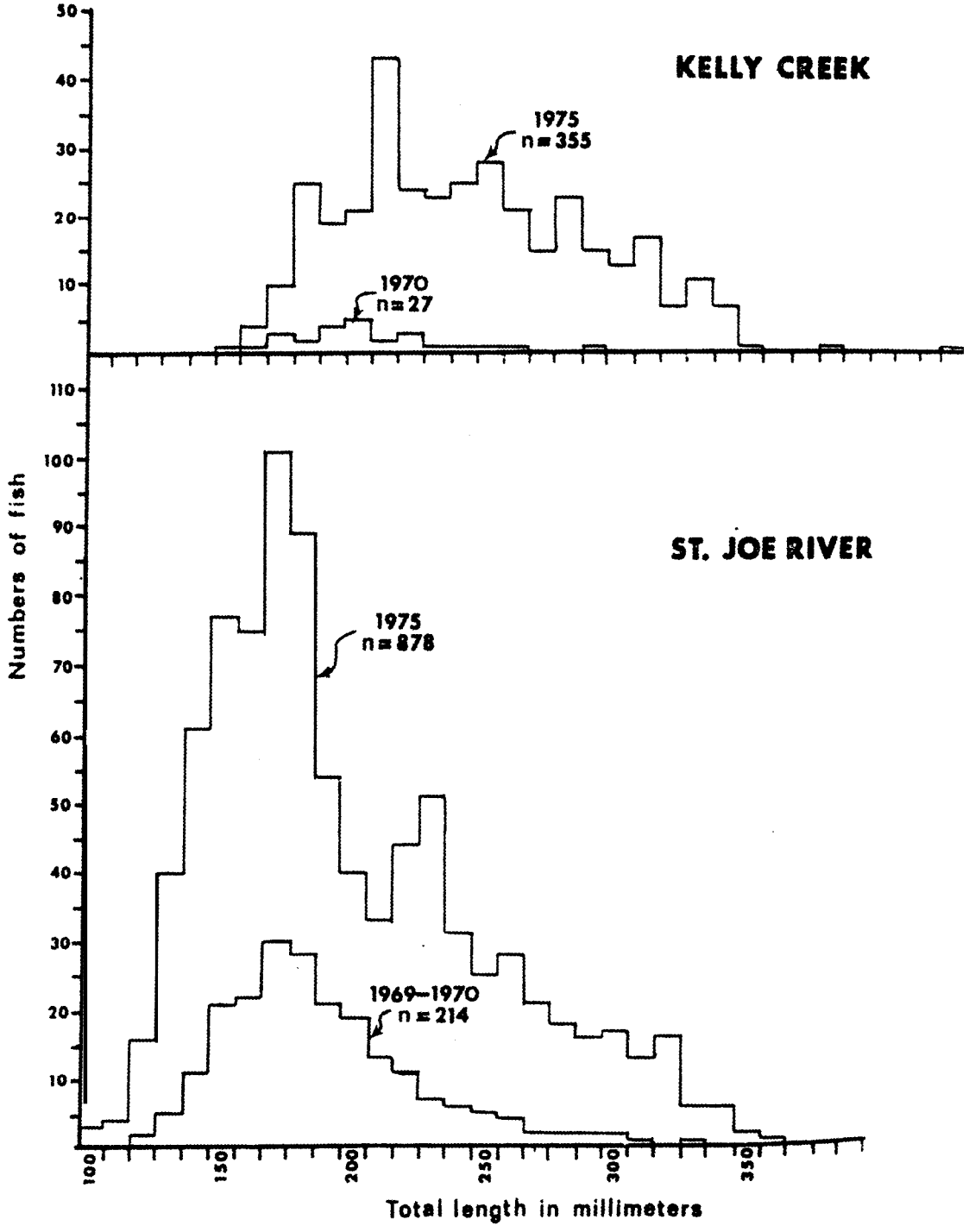


Figure 17. Abundance and size distribution of cutthroat trout i
Creek transects (Kelly Forks to Moose Creek) in 1970 and 1975, a
Joe River transects (Prospector Creek to Ruby Creek) in 1969-19

In Kelly Creek, we counted 13 times more cutthroat trout of all sizes in the transects from Kelly Forks to Moose Creek in 1975 (n = 355) than in 1970 (n = 27) (Fig. 17). The 1970 counts include some cutthroat which were saved by the catch-and-release regulations as we counted only 11 cutthroat in the transects in 1969. In 1975, 210-260 mm cutthroat were the most abundant size group compared to 190-210 mm cutthroat in 1970. The number of large (.250 mm) cutthroat in our samples increased from four fish in 1970 to 160 fish in 1975, evidence that small fish were surviving the catch-andrelease fishery. Spawner-sized cutthroat (>310 mm) in our Kelly Creek samples increased from one fish in 1970 to 45 fish in 1975 (Fig. 17). We cannot readily explain the absence of cutthroat smaller than 150 mm in Kelly Creek. Thirty percent of the cutthroat collected from Kelly Creek in 1975 entered the main river after two years of growth in the tributaries, so we should have caught more fish 100-149 mm long. Since we did catch cutthroat 100-149 mm long in the St. Joe River in 1975 (Fig. 17), we believe that cutthroat smaller than 150 mm in Kelly Creek were not vulnerable to angling.

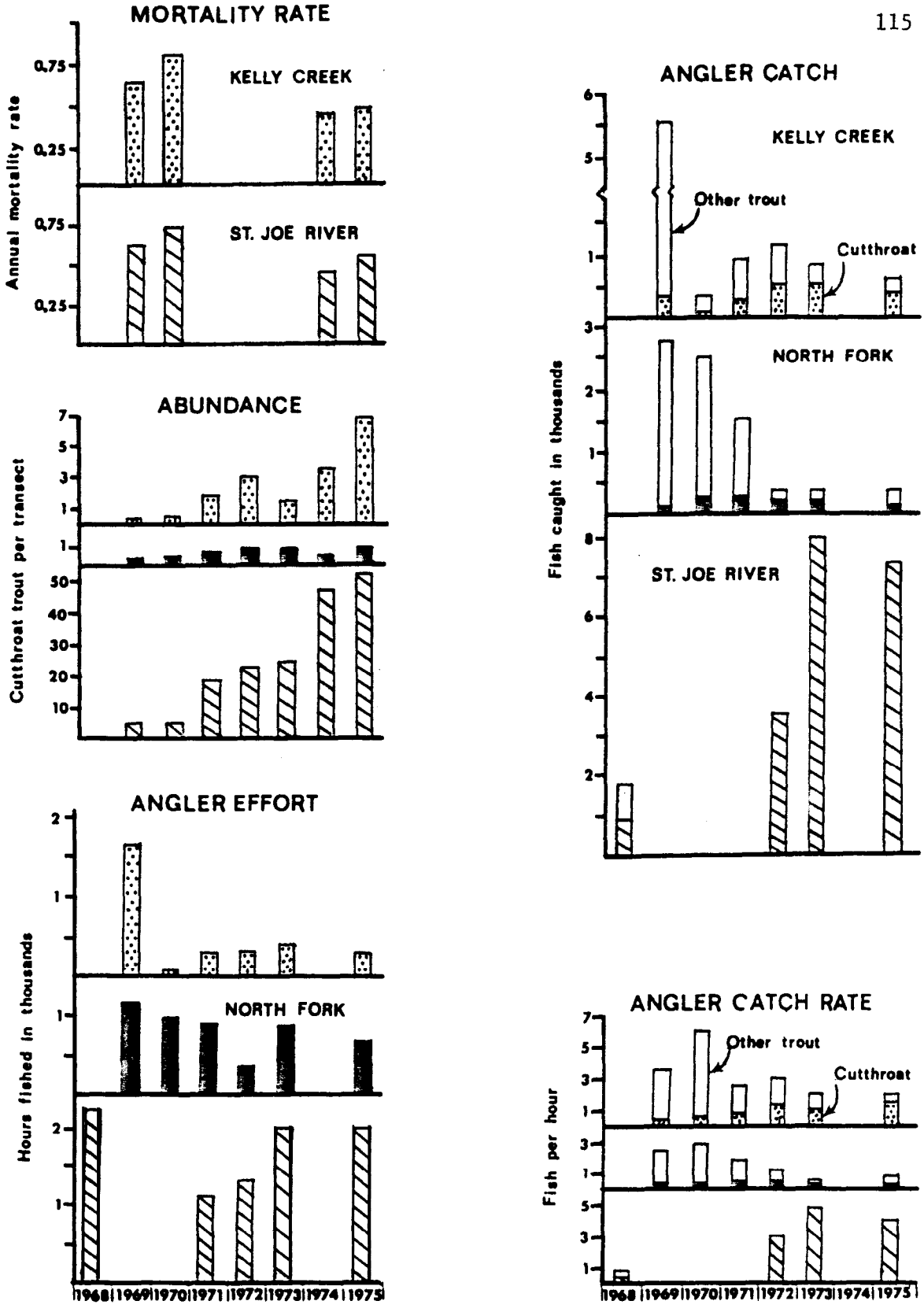
The catch-and-release and trophy-fish angling regulations allowed additional cutthroat to survive and spawn at least once. However, larger numbers of mature trout may not necessarily produce increased numbers of fry. Benson (1960), McFadden (1961), and Drummond and McKinney (1965) observed that the number of trout spawners did not bear any consistent relationship (in a regression sense) to the production of immature trout. Bulkley and Benson (1962), Latta (1965), and Drummond (1966) observed a direct correlation between low water flows and strong year classes of trout. In the populations studied by the above authors, trout fry abundance was regulated by environ-

In the case of Kelly Creek and the St. Joe River, I believe that additional mature cutthroat produced more cutthroat fry. Trout populations studied by Benson (1960), McFadden (1961), and Drummond and McKinney (1965) were at densities of parental stock such that the number of spawners was not a major factor in regulating the amount of recruitment. Since the cutthroat spawning stock of the upper St. Joe River and Kelly Creek had been seriously depleted by 1969 and 1970, the density of cutthroat spawners was a major factor in the number of recruits produced.

Fishery Provided with Special Angling Regulations

Sixty percent of the anglers interviewed in a statewide survey of Idaho anglers in 1968 thought catch-and-release regulations deserved testing and 49% said they would fish waters managed with catch-and-release regulati′ (Gordon et al. 1969). Eighty-eight percent of the anglers interviewed in 1969-1970 while fishing the upper St. Joe River favored the implementation of special angling regulations to save the native cutthroat population (13j 1975). In both the St. Joe River and Kelly Creek, however, angler effort creased when the special angling regulations were put into effect. On th St. Joe River, the *number* of hours fished by anglers had increased to prc special regulation levels by 1975, but angler effort on Kelly Creek in 1 was only 20% of 1969 levels (Fig. 18).

Angler acceptance of catch-and-release and trophy-fish angling r lations was excellent. More than 90% of the anglers interviewed in 19; favored the special angling regulations (Question 6, page 98). In add most (73-94%) anglers fishing areas managed with special regulations f `''mot fishing was better in 1975 compared to before initiation of spec



igure 18. Annual mortality rate and abundance of cutthroat trout, and hours ished

managed with standard regulations thought that angling had remained the same or had declined (Question 3, page 95). The decline in angler effort on Kelly Creek, however, may indicate general dissatisfaction with the catch-andrelease program among anglers in northern Idaho.

As a result of trophy-fish angling regulations, angler catch and angler catch rate of trout per hour increased in the upper St. Joe River (Fig. 18). Increases in angler catch and angler catch rates in the St. Joe River are especially meaningful since stocking with hatchery-reared rainbow trout was discontinued in the trophy-fish area in 1971. Rainbow trout made up 50% of the total catch by anglers in 1968, but only comprised 2% of the catch in 1975 (Fig. 18). In Kelly Creek and the North Fork of the Clearwater River, angler catch and angler catch rate of trout per hour were smaller in 1975 than in 1969 (Fig. 18), primarily because of decreased numbers of steelhead in the catch on each stream. However, anglers caught more cutthroat per hour in Kelly Creek in 1975 than in 1969 while the catch rate of cutthroat was virtually unchanged in the North Fork (Fig. 18). Changes in standardized catch rates of project personnel better indicate changes in the cutthroat fisheries in Kelly Creek and the North Fork. Catch data which only includ[e] the more efficient anglers offer a more precise estimate of fishing qualit[y] than do data on average catch per hour (Rupp 1961). The increase in catch rate of cutthroat by project personnel from 0.6 cutthroat/hour in 1969 to 2.4 cutthroat/hour in 1975 indicates an improvement in the fishery for cu[t]" throat trout with catch-and-release regulations; catch rates of cutthro[at] were about the same in the North Fork in 1969 (0.2 cutthroat/hour) and 197' (0.4 cutthroat/hour) with standard regulations (Table 19).

Increases in the abundance of cutthroat trout in Kelly Creek and the upper St. Joe River were responsible for the improvements in the cutthroat fisheries. While fishing the St. Joe River, anglers caught 8 times more cutthroat and 9 times more cutthroat/hour in the section of river from Gold Creek to Spruce Tree Camp in 1975 than in 1968, and cutthroat abundance increased more than 9-fold in transects in this section from 1969 to 1975 (Fig. 18). While anglers caught 6 times more cutthroat/hour in the section of Kelly Creek from Kelly Forks to Moose Creek in 1975 than in 1969, cutthroat abundance increased more than 13-fold in transects in this section from 1970 to 1975 (Fig. 18). In addition, if the number of hours fished by anglers in telly Creek had not declined, I believe that anglers would have caught more utthroat in 1975 than in 1969.

A change in the expertise of anglers fishing the St. Joe River and .elly Creek may have affected angler catch and/or angler catch rates, but my slightly. Since about 80% of the anglers interviewed while fishing the t. Joe River in 1975 had fished the St. Joe River shortly before the initiion of trophy-fish regulations (Question 3, page 95), it is unlikely that anges in the angler population resulted in appreciable increases in angler tch and angler catch rates. On Kelly Creek, only 23% of the anglers inter-!wed while fishing Kelly Creek in 1975 had fished Kelly Creek in the late O's (Question 3, page 95), and we interviewed fewer young (414 years old) fewer old (.N.45 years old) anglers in 1975 than in 1969 (Table 47). It likely, therefore, that the mean angler catch rate was smaller in 1969 tly due to the wider range of angler expertise, especially among younger <ers. *Although we interviewed* more fly fishermen and fewer bait fishermen

and 51) an increase in the proportion of fly fishermen did not necessarily

reported that fly fishermen caught

(1955) from 2 times as many trout per hour as bait fishermen in the Sunkhaze

to 4 with bait and Stream, Maine, but Rankel (1971) noted that anglers fishing similar catch rates on the upper St. Joe River in 1969 and 1971, had anglers ac-

tilted Multiple recaptures of cutthroat caught and released by cutthroat in Kelly for some of the increase in angler catch rates of

upper St. Joe River. Since anglers fished more hours in the Creek and the f cutthroat probably St. Joe River than in Kelly Creek, multiple recaptures o affected the catch rate of cutthroat more in the St. Joe River than in Kelly Creak.

loitation of Without catch-and-release regulations, I believe overexp population in Kelly Creek would have increased as steel- the. cutthroat trout on the North head became less abundant. The cutthroat population and fishery when the daily bag limit was reduced from 15 fish to Fork tailed to improve w p op" 3 ash. Because of the inverse relationship between the proportion of laticm harvested and size of the population as reported by McFadden (1961)

verexploitation of the cutthroat trout population and llu it et al. (196[2]) , ° in Krll Creek would have increased without special regulations. Y

Catch-and-Release and Tro•h -Fish An:lin Regulations

Cm arisen of is study was to compare effects of catch One of the objectives of this -fish angling regulations on native cutthroat trout a ~l-~ ~~ lease and trophy discovered be- Populations and fisheries. Because of inherent differences 0r1 Kelly Creek and the upper St. Joe River' t~~rrt cutthroat populations of

throe comparisons seem valid.

First, anglers fished more hours under trophy-fish regulations than under catch-and-release regulations. Angler effort on the upper St. Joe River declined when trophy-fish regulations were initiated in 1971, but angler effort increased to pre-special regulation levels within three years. Angler effort also declined initially with catch-and-release regulations, but angler effort remained low. Apparently the opportunity to keep a few large cutthroat was important to anglers in northern Idaho.

Secondly, cutthroat survived longer and grew to larger sizes in Kelly Creek under catch-and-release regulations. Trophy-fish regulations allowed anglers to harvest cutthroat longer than 13 inches, leaving few cutthroat longer than 15 inches in the St. Joe River. Cutthroat grew to lengths of 17 inches or longer in Kelly Creek since all fish had to be released by anglers (Fig. 19).

Third, in 1975, the annual mortality rate of the upper St. Joe River cutthroat trout population was slightly larger with trophy-fish regulations than the mortality rate of cutthroat in Kelly Creek with catch-and-release regulations. In 1975, estimated mortality rates of fish age III to IV were about the same on the two streams and were estimates of natural mortality and hooking mortality combined. The mortality rates of age IV and older fish were larger in the upper St. Joe River than in Kelly Creek (Tables 42 and 44). Angler harvest and probably some spawning mortality increased the mor[t]ality rate of age IV and older cutthroat in the upper St. Joe River. In [a]ddition, since more fishing occurred in the upper St. Joe River than in [K]elly Creek, the probability of catching and releasing sublegal cutthroat 'as larger in the St. Joe River. More frequent handling of cutthroat by [a]nglers on the upper St. Joe River may have increased the mortality of sub-

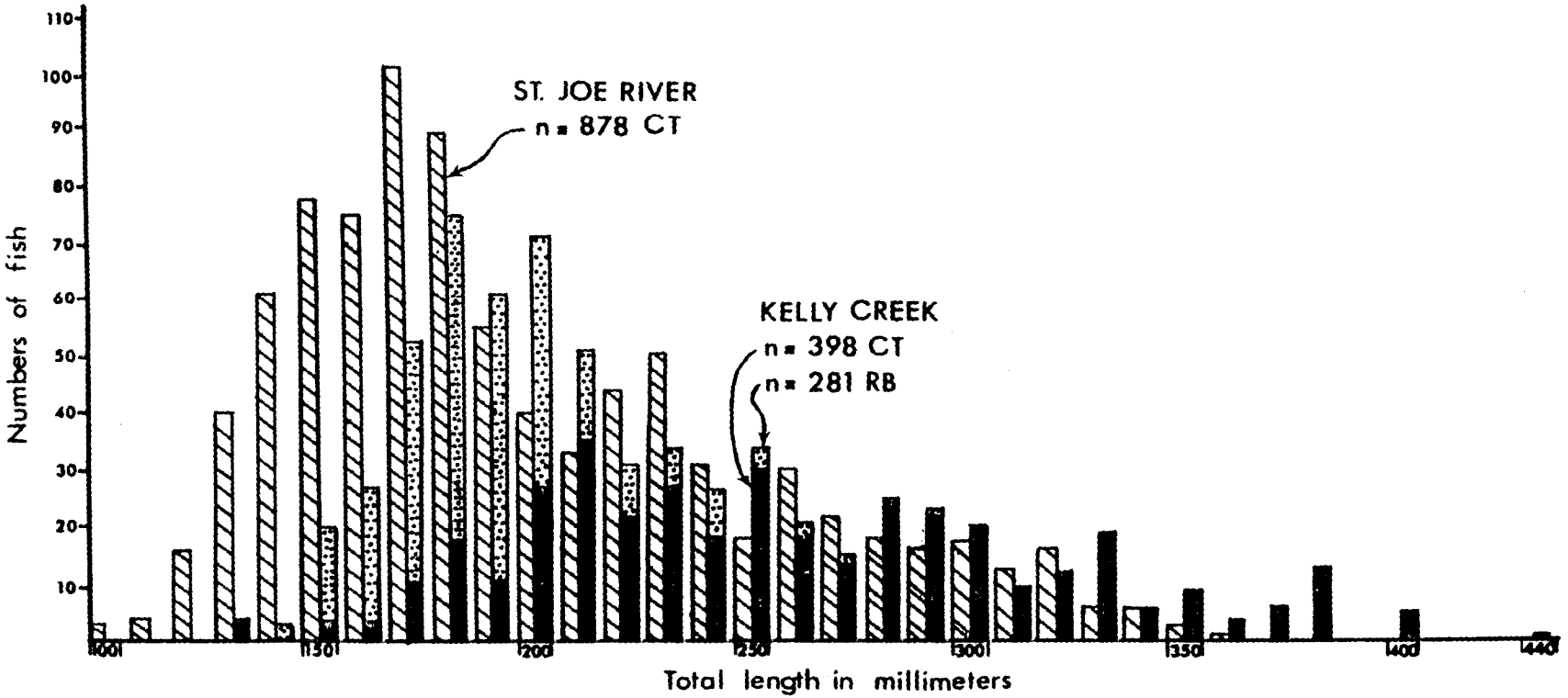


Figure 19. Abundance and size distribution of cutthroat and rainbow trout in 21 comparable transects in the Kelly Creek and upper St. Joe River study areas, 1975. Size distributions from project person-

A variety of factors made further comparisons of the special angling regulations difficult. First, a difference in the initial number of cutthroat trout in the two streams made difficult a comparison of changes in abundance or size structure of the populations, and changes in angler catch or angler catch rates. Secondly, differences in age and size at maturity of cutthroat in the two streams may have affected the rate of response of the cutthroat trout populations. Third, the fish community in Kelly Creek was more complex than that in the upper St. Joe River (Tables 13 and 15); thus inter-specific competition for food and/or space may have limited the abundance of cutthroat trout in Kelly Creek (especially some age groups). In fact, it appears that rainbow trout in Kelly Creek are partially filling a niche occupied only by cutthroat trout in the upper St. Joe River (Fig. 19). As has been pointed out by Brian (1956), competition through "exploitation" where species do not directly interact in their behavior, and competition by "interference" in which one animal directly influences the activity of another through their behavior, are distinct forms of inter-specific competition. Both of these
Forms of competition may have operated on Kelly Creek and limited the abundance)f cutthroat trout.

Movements of Cutthroat Trout

Returns of cutthroat tagged and released in the three study streams dicate that cutthroat migrated upstream into the upper drainages in the 'ring and early summer, few cutthroat moved during the summer, and cutthroat grated downstream to lower portions of the drainages in the fall (Figs. 13, 15, and 16). Most studies on movement of trout in streams report that out confine themselves to a short segment of stream (usually "'

Cutthroat trout and other salmonids in northern Idaho streams characteristically exhibit a winter cover-seeking behavior. Bjornn and Mallet (1964), Chapman and Bjornn (1969), and Thurow (1976) observed fall downstream movements of cutthroat to "deep water" winter cover. A number of researchers (Everest 1969, Miller 1970, Mauser 1972, Morrill 1972) observed that some salmonids enter interstices of the substrate at temperatures below 5° C. Chapman and Bjornn (1969) hypothesized that fall downstream movements and shelter-oriented winter behavior in relatively cold streams may be a means of (1) avoiding unprofitable energy expenditure, (2) predator avoidance, or (3) preventing physical damage by scouring and ice. Such fall-winter migrations may be related to the winter carrying capacity of upstream areas as we suggested by Bjornn (1971) for Big Springs Creek, Idaho.

The downstream fall migrations of cutthroat trout in the St. Joe River and the North Fork of the Clearwater River (including Kelly Creek) probably increased the overwinter survival of cutthroat trout. Studying the effects of various special angling regulations, Hunt et al. (1962), Shetter (1969), and Klein (1974) reported that increased natural mortality (primarily winter mortality) prevented an increase in the number of large trout in the streams studied. Apparently all overwinter habitat was utilized by trout these streams. Hunt (1971) reported an increase in the number of large br trout in Lawrence Creek, Wisconsin, following an increase in the amount an quality of overwintering habitat.

Since the number of cutthroat observed in the St. Joe River and Ke Creek transects increased from year to year (Figs. 6 and 8), the overwint

carrying capacities of the two streams probably have not been reached.

However, that once overwinter carrying capacities have b

attained, cutthroat saved from angling mortality will succumb to overwinter or other natural mortality, and not be available to anglers in following years.

Cutthroat returning to Kelly Creek in the spring contributed to the cutthroat fishery in the North Fork of the Clearwater River downstream from Kelly Forks. An increase in harvest of cutthroat in the lower North Fork apparently is not endangering the cutthroat population in Kelly Creek, but may be dampening observed effects of catch-and-release regulations. Anglers fishing on the lower North Fork from May to early July harvested 1837 cut-throat in 4428 hours of fishing in 1974 compared to 659 cutthroat in 4093 hours of fishing in 1969. Increased recruitment of cutthroat from tributaries to the lower North Fork may have accounted for some of the increase in cut-throat harvest (Table 52). Harvest of cutthroat in the lower St. Joe River may be dampening observed effects of the trophy-fish regulations in the upper drainage.

The Role of Special Angling Regulations in Trout Management

Special angling regulations have become increasingly important in the management of trout populations. The present and projected status of the human population suggests that management of a trout population and fishery in many situations must emphasize sporting aspects of fishing and regulate harvest of fish to a minor role. Special angling regulations have been implemented for a variety of reasons, but most with the intent of limiting or reducing harvest of fish by anglers. Restrictive regulations have been initiated to (1) perpetuate native trout stocks, (2) reduce angler-caused mortality,

Table 52. Hours **fished** and cutthroat trout harvested by anglers fishing the North Fork of the Clearwater River downstream from Kelly Forks, May 25 to July 10, **1969-1975;** and number of cutthroat trout collected with explosives (Prima-cord) from selected pools on tributary streams in the North Fork of the Clearwater River during August, 1969-1975 (Cannon 1971, Ball and Pettit 1974, Pettit et al. 1975, Pettit 1976).

Year	Hours fished	Cutthroat trout harvested	Cutthroat trout collected in tributaries
1969	4093	659	14
1970	4041	775	10
1971	3796	627	14
1972	2629	723	11
1973	5020	1273	41
1974	4428	1837	22

1975	6511	1594	48

harvest at a larger size, (5) increase average size of fish in the catch, (6) increase catch rates by catching the same fish more than once, (7) maintain quality trout fishing without replenishment with hatchery-reared trout, (8) improve trout fishing at the request of the angling public, (9) redistribute the catch among anglers, (10) encourage sporting aspects of fishing, (11) provide a unique fishery, and (12) diversify angling opportunities in an area (Ricker 1945, Hobbs 1948, Allen 1954, Hunt et al. 1962, Wallis 1963, Stenton 1964, Hunt 1970, Ball 1971, Klein 1971, Montgomery 1971, Rankel 1971, Ratledge et al. 1971, Lantiegne 1974, Oatis 1975, Radford 1975b).

Management of trout populations with special regulations has met with nixed success. In order for special angling regulations to function effec-:ively, fishing must be limiting the population below inherent trout-producing apabilities of the stream. If environmental or genetic factors are the)rimary limiting factors, protection of fish from fishing mortality will ultiately be compensated for by increased natural mortality. In situations where fishing was limiting trout populations, special angling regulations have worked _fectively.

.tthroat Trout

Rankel (1971) concluded that overfishing caused the reduced abundance the cutthroat population of the upper St. Joe River. Over-exploitation s most likely the cause for the reduced cutthroat population in Kelly Creek. ice initiation of special angling regulations on these two streams, angler - vest and annual mortality rates declined, more cutthroat were allowed to w to maturity and spawn, and abundance of cutthroat increased dramatically.

Other biologists observed the rapid response which cutthroat trout

In tributaries to the St. Joe River, Thurow (1976) reported a significant increase in cutthroat abundance after 2 years of closure to angling. Alternate closed seasons permitted adequate spawning escapement and allowed cut-throat trout in Dutch Creek and the Oldman River, Alberta, to grow to a more desirable size (Radford 1975a, I975b). A population of Paiute cutthroat trout in Silver King Creek, California, showed approximately a 10-fold increase in numbers and weight over an 8-year period of closure to angling (personal communication from E.C. Fullerton, California Department of Fish and Game 1975). Lowry (1966) observed an increase in abundance of coastal cutthroat trout in tributaries closed to angling. The cutthroat trout population of the Yellowstone River in Yellowstone National Park increased in abundance whrr managed with catch-and-release regulations (personal communication from J.U. Varley, U.S. Fish and Wildlife Service 1976).

Brook Trout

Fishing was probably not limiting brook trout, Salvelinus fontlis (Mitchill), populations in most of the studies I reviewed involving special angling regulations. Most studies were conducted in streams or stream sections with good to excellent natural reproduction. In these cases, special regulations often allowed more adult trout to survive the summer, but recruitment did not increase appreciably (Hunt at al. 1962, Shetter and Alexander 1965, Shetter 1969, Hunt 1970).

Where fishing was limiting brook trout populations, special angling regulations worked successfully. Shetter, Whalls, and Corbett (1954) reported that a 10-inch minimum size limit and flies-only restriction provided protection to a high proportion of brook trout spawners, resulting in an 'n'

in the abundance of brook trout; in a section managed with normal angling regulations, population abundance did not increase. Lantiegne (1974) stated that an excessive rate of exploitation was probably limiting the brook trout population in the Batten Kill, New York. After a 12-inch minimum size limit and no-bait restriction were imposed, density of brook trout increased. While few brook trout were harvested, they were important to the catch-andrelease segment of the brown trout-brook trout fishery due to their extreme vulnerability to angling.

Rainbow Trout

Klein (1974) reported that a population of wild rainbow trout in the Cache La Poudre River, Colorado, was not endangered by normal fishing and stocking procedures. Since fishing was not limiting the population, special management that included elimination of stocking, elimination of bait fishing, and imposition of a 12-inch minimum size limit did not substantially increase the abundance of rainbow trout. Klein did report a shift in the size structure of rainbow trout from one of mostly 8.0-8.9 inch fish to one of 10.0-10.9 inches, and a reversal with the removal of the minimum size limit.

Brown '"rout

Gowing (1975) reported that Gamble Creek, Michigan, contained a nearly unexploited population of brown trout, Salmo trutta Linnaeus. Rate of exploitation averaged 8.1% for age groups II through VI. Densities of both fingerlings and legal-sized trout increased after closing the stream to fishing for 3 Years, but Gowing believed that movement of trout into the closed section probably accounted for the increases. Lantiegne (1974) stated that an exces-

in the Batten Kill, New York. After special regulations (12 inch size 3 fish bag limit, artificials only) were imposed, the density of brown trout increased. Fishing was probably limiting the wild brown trout population in Wiscoy Creek, New York, since the standing crop of wild brown trout was 66 pounds per acre in posted (private) and unstocked sections, but less than 30 pounds per acre in heavily-fished sections (Pomeroy 1975). The standing crop of wild brown trout in heavily-fished sections increased significantly with initiation of restrictive angling regulations, in two years exceeding 66 pounds per acre.

If a stream is capable of supporting a larger trout population, trout species which are more easily exploited are more likely to respond to special angling regulations. The relative vulnerability to angling of different crow species and fishing intensity control the rate of exploitation. Shetter any. Alexander (1965) and Lantiegne (1974) found brook trout much easier to catch than brown trout and MacPhee (1966) found cutthroat trout about twice as susceptible to angling as brook trout. Under normal angling regulations, the rate of exploitation of cutthroat longer than 150 mm ranged from 0.70-0.76 or higher in Alberta (Radford 1975a, 1975b) and Paiute and Lahontan cutthroat trout were exceptionally vulnerable to angling (personal communication from E.C. Fullerton, California Department of Fish and Game 1975). t normal angling regulations in effect, rates of exploitation of brook trout populations ranged from 0.32-0.65 (McFadden 1961, Hunt et al. 1962). Angl'· exploitation rates of brown trout populations ranged from 0.06-0.43, but usually above 0.13 (Allen 1951, Marshall 1973, Gowing 1975).

I expect that cutthroat trout will respond to special regulations

z-- "rank trout, and brook trout more often than brown trout; but a^'

population will respond to special angling regulations if fishing is ing the population.

Special angling regulations are more likely to be needed to preserve populations in unproductive streams than in productive streams. Cer- characteristics of trout populations in unproductive streams tend to the populations more vulnerable to exploitation. In the cases we re- d (Carlander 1969), it appears that trout grow slower, live longer, and at an older age in unproductive streams than productive streams, ining the chance of harvest and allowing relatively fewer fish to survive pawn. Where spawners are scarce, egg production and recruitment may be than needed to sustain the population. Trout in unproductive streams ave lower fecundity (Carlander 1969), which apparently provides for resilience against the effects of fishing (Royce 1975). Since stream :ctivity and fish production are positively related (Warren et al. 1964), !r harvest is more likely to exceed production in unproductive streams, ting in a decline in abundance of trout.

Special angling regulations that increase survival increase reproducand production of exploited trout populations, especially in unproductive ms. Hunt et al. (1962), Shetter (1969), Hunt (1970), and Latta (1973) lated that, while special angling regulations were not necessary in no they studied, restrictive regulations would prove effective in unactive streams or where recruitment was limited. It should be re-empha- that trout populations in productive streams, if limited by fishing, also respond favorably to management with special angling regulations.

Development of quality fishing is often mentioned as a reason for implementation of special angling regulations. The question comes to mind, "What is 'quality' fishing?"; or more appropriately, "What is a 'quality' fishing experience?". McFadden (1969) reported that a study of a trout fishery in the western United States by Brown (1968) showed that trophy trout anglers perceived quality of their fishing experience primarily in terms of size and number of fish caught. More recent studies by Bull (1972) in British Columbia, Moeller and Engleken (1972) in New York, and Radford and Wiebe (1975) in Alberta, have shown that elements of the natural environment (water quality, natural beauty, solitude, etc.) were consistently rated by anglers as the most important factors influencing fishing enjoyment, although native, wild fish were much sought after. The opportunity to fish or need to escape temporarily from stressful conditions is a major motivation in recreational activities like fishing (Olson and Wallace 1969, Anonymous 1973).

Special angling regulations are a tool fish managers can use to maintain wild trout populations, even as use of streams increases. By providing the opportunity to catch a wild or native trout, special angling regulations can contribute to a 'quality' fishing experience, but do not necessarily constitute a 'quality' fishing experience of themselves. Fishery managers should recognize the aesthetic and historical importance of fish population and make provisions for their non-consumptive appreciation and understanding by the general public.

naement O.tions While Protectin: the Cutthroat Trout Ponulation s

Given that the native cutthroat trout populations of Kelly creek or the upper St. Joe River should be protected and perpetuated, restrictive angling regulations should be continued on the streams to limit angle'e'u,

mortality. In this section, I discuss some management options for the cutthroat trout populations and fisheries.

1). Stream closure

Closing Kelly Creek or the upper St. Joe River and their tributaries to angling would provide maximum protection to the wild cutthroat trout populations. However, the angling public would lose the streams as recreational areas.

2). Catch-and-release angling

Catch-and-release regulations have effectively protected the cutthroat trout population in Kelly Creek and would do so in other similar streams. In infertile streams of north Idaho, catch-and-release regulations allow cutthroat trout populations to reach maximum abundance (especially of large fish), and anglers enjoy maximum catch rates, but benefits associated with catching and keeping fish (even a few) are foregone.

3). Minimum size limit

A minimum size limit would protect the cutthroat trout populations. The size limit applies to every trout caught and can be related to a rather stable biological parameter, growth rates of the trout population (Hunt 1970). With a minimum size limit such as on the St. Joe River, most fish can be protected until after they spawn the first time, population abundance is near maximum, fish longer than the minimum limit can be kept and are, therefore, not as abundant as with a catch-and-release fishery. Other researchers have reported that minimum size limits were effective in preventing excessive angler harvest of trout populations (Hunt et al. 1962, Shetter 1969, Hunt 1970).

4). Bag limit

A reduced bag limit would not adequately protect the cutthroat trout populations. A 3 fish bag limit did not protect the cutthroat trout population in the North Fork of the Clearwater River upstream from Kelly Forks, even as angler effort declined. Since a bag limit does not apply to every fish caught, bag limits offer no protection to fish populations until the limit is reached and are ineffective in controlling angler harvest (Shetter 1969, Hunt 1970, Montgomery 1971a). Gerstung {1975) reported, however, that a reduction in the bag limit from 10 to 2 fish was effective in reducing angler harvest of trout in Hat Creek, California. If anglers are willing to accept a less abundant cutthroat trout population and lower catch rates, a bag limit of one fish would provide a larger harvest of cutthroat without necessarily threatening the cutthroat populations.

A bag limit could be implemented in combination with a minimum size limit to distribute the catch among the anglers. A small daily bag limit {3 or fewer fish) may prevent much vocal discontent among anglers concernin[g] fish hogging (Hunt 1970).

5). Gear restrictions

Restriction of fishing methods alone would not effectively protect the cutthroat trout populations. When tested as the only variable, artifi[ce'·] lures-only or flies-only restrictions did not appreciably benefit trout [pOPU"] lations studied by Shetter and Alexander (1962), Shetter (1969), Hunt (1970' or Latta (1973).

Prohibiting the use of bait in combination with a minimum size limi[t] is effective and sometimes necessary to limit mortality of fish due to hoo[k-] ing injury. Fish released after being caught using bait sustain high[er]

mortality rates (20-73%) than fish caught on artificial lures and flies (0-13%) (Table 53).

Restrictions on the use of treble-hook lures and/or barbed hooks contribute little to the reduction of total mortality of trout which are caught and released. Post-release mortality attributable to flies and lures is generally less than 10%, and studies done in the United States and Canada have revealed no differences in the mortalities to trout by anglers whether barbed or barbless hooks were used (Table 53). Some anglers believe such restrictions are needed and would use single and/or barbless hooks without being required to do so. From 22 to 50% of the anglers interviewed while fishing the three study streams in 1975 thought that barbless hooks should be required wherever special regulations were in effect in spite of our statement that such restrictions were probably not needed to reduce hooking mortality (Question 9, page 101).

6). Shortened fishing season

A shorter angling season would not effectively protect the cutthroat spawning stock unless it was very short. Concentrated angling effort during a shortened season may harvest sufficient fish to reduce the abundance of cutthroat trout spawners. A season which is too short would be unpopular with anglers and limit the recreational use of the area.

Kelly Creek

Catch-and-release regulations protected cutthroat trout in Kelly Creek from angler harvest and allowed the population to increase in abundance. Popularity of the catch-and-release program is excellent among those anglers fishing Kelly Creek. To document the full effect of catch-and--elease regu-

Table 53. Percentage hooking mortalities of rainbow trout (RB), brook trout (Brk), brown trout (Brn), cutthroat trout (CT), lake trout (LT), coho salmon (Co), and chinook salmon (Ck) when bait or barbed and barbless flies and treble-hook lures were used.

Method	Study (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Barbed hook*	4.0	--	--	--	--	8.0 (Ck) 12.6 (Co)	--	--	--	--
Barbless hook*	--	--	--	--	--	6.1 (Ck) 8.6 (Co	--	--	--	--
Barbed fly		1.5 10.3	7.9	0 (Brn) 1.3 (RB) 1.4 (Brk)	0 (Brn) 3.3 (Brk) 11.3 (RB)	--	--	0.39	5.9	4.0
Barbless fly	--	--	--	--	--	--	--	0.76	5.0	3.3
Barbed treble	--	1.8 4.8	2.8	1.5 (Brn) 3.9 (Brk) 6.3 (RB)	--	--	6.94	2.39	--	2.7
Barbless treble	--	--	--	--	--	--	7.02	1.21	--	6.0
Bait (not swallowed)	--	--	--	-^	--	--	--	--	3.3	8.2
Bait (swallowed)	--	--	^-	--	--	--	--	--	--	73.0
Bait	--	--	36.0	--	20.3 (Brn) 35.4 (RB) 42.4 (Brk)	--	--	--	--	--
Snecies		RB	RB	Trout	Trout	Salmon	LT	CT	7?	CT

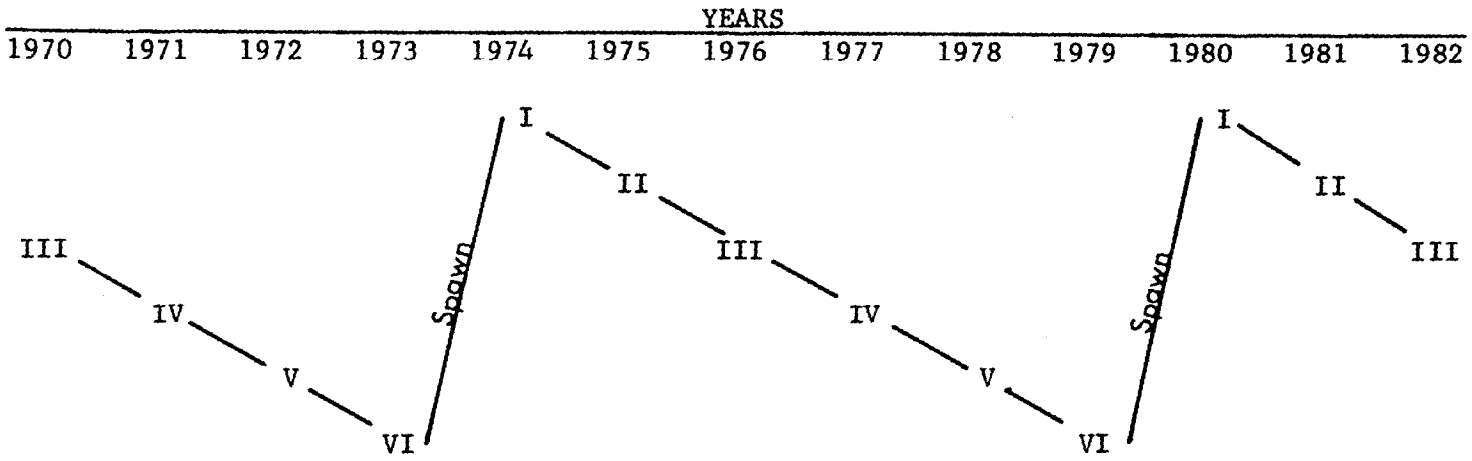
*Fly and treble-hook combined.

(1) Mallet (1963).
(2) Klein (1965).
(3) Stringer (1967).
(4) Shetter and Allison (1958)
(5) Shetter and Allison (1955)
(6) Butler and Loeffel (1972).
(7) Falk, Gillman, and Dahlke (1974).
(8) B)ornn, Idaho Coop. Fish. Unit.
(9) 1h,smpson (1946).
(101) u.n,sVcr, thrncll, and Sharpe (1970).

.oat trout population in Kelly Creek reaches maximum density. Age III oat were the most abundant age group in Kelly Creek in 1970 (Table 41). "I cutthroat "saved" by the catch-and-release regulations starting in robably spawned at age VI in 1973, and their offspring would spawn in 'Fig. 20). The effect of catch-and-release regulations on trout abun- and age structure will be more fully evident in 1981 and 1982 when age age III fish of the 1979 year class enter the river and are counted snorkeling transects.

Once the cutthroat trout population has attained maximum abundance, management options for the Kelly Creek fishery can be considered. use of Kelly Creek has declined by about 8070 since catch-and-release :ions were initiated, indicating that many anglers were not fully ed with the catch-and-release program on Kelly Creek. Gordon (1970) 2d that the opportunity to harvest trout was important to anglers re- in the Clearwater River drainage.

It is possible to maintain a healthy cutthroat trout population in reek and allow a harvest by anglers. Although anglers using Kelly n 1975 expressed a preference for catch-and-release regulations (Ques- page 97), preferences of other anglers should be assessed. In most :utthroat surviving to the end of the summer would spawn the following Jefore being subjected to the fishery in Kelly Creek. Unless harvest -moat from the North Fork of the Clearwater River downstream from Kelly zcreases appreciably, this fishery will not adversely affect the cut-)opulation in Kelly Creek. Fishery managers should consider changing Ling regulations on Kelly Creek to allow a limited harvest of cutthroat



gure 20. Age III cutthroat trout "saved" by the catch-and-release regulations starting in 1970 obably spawned at age VI in 1973, and their offspring would spawn in 1979. The effect of the tch-and-release regulations on trout abundance and age structure will be more fully evident in 81 and 1982 when age II and age III fish of the 1979 year class enter the river and are counted the snorkeling transects.

Since most cutthroat in Kelly Creek spawn first at age VI (Table 38), cutthroat should be protected through their sixth summer of life (age V). Minimum size limits of 12 inches or longer would protect many cutthroat in Kelly Creek up to the time of first spawning since age VI cutthroat averaged 12.1 inches (306 mm) at the time of annulus formation in the spring (Table 27). In 1975, of 70 age V cutthroat collected and measured by project personnel during the summer, 30 (42.9%), 18 (25.7%), 2 (2.9%), and 0 (0%) were longer than 12, 13, 14, and 15 inches, respectively, and would be of a legal size under these respective size limits. Of 142 age IV cutthroat collected and measured by project personnel during the summer, 4 (2.8%) were longer than 12 inches, and none were longer than 13 inches.

A better estimate of the effects of 12-, 13-, 14-, and 15-inch minimum size limits on the number of cutthroat surviving to first spawning is the proportion of cutthroat longer than each proposed size limit at the end of their sixth growing season (age V). These estimates would account for growth of cutthroat during the entire season, and include all cutthroat which would reach the minimum size during the season. Of 70 cutthroat that we aged as 5 years old, 41 (58.8%) would be longer than 12 inches, 21 (30.0%) longer than 13 inches, 3 (4.3%) longer than 14 inches, and none longer than 15 inches by the end of their sixth growing season (age V). Of 142 cutthroat aged as 4 years old, 9 (6.3%) would be longer than 12 inches at the end of their fifth growing season (age IV). All of the age V cutthroat we inspected and projected to be longer than 12 inches were mature and would have spawned the next spring at age VI.

If anglers caught all of the cutthroat trout in Kelly Creek longer

the cutthroat would be harvested before they had spawned once. Such a harvest of spawners might reduce abundance of spawners below the number required for full seeding of the streams.

If anglers caught all of the cutthroat which would be longer than 14 inches at the end of their sixth summer of life, only 4-7% of the cutthroat would be harvested before spawning at least once. A 15-inch minimum size limit would provide adequate survival of spawners as none of the cutthroat would be harvested before spawning. Since many anglers may not accurately measure all fish they catch, some cutthroat smaller than the minimum size may be harvested. Setting the size limit at 14 or 15 inches would allow for harvest of some cutthroat under the minimum size limit and still protect an adequate number of spawners.

Initiation of a minimum size limit may have several effects on the cutthroat trout population and fishery in Kelly Creek. First, with the opportunity to keep large cutthroat, angler use of *Kelly* Creek would probably increase. Many anglers interviewed while fishing the North Fork in 1975 preferred to fish a stream where they could keep a few large fish compared **to a stream where all fish had to be released (Question** 4, **page 97).** Seca anglers not successful in catching a legal-sized fish would enjoy an excel fishery for native cutthroat trout. Third, abundance of cutthroat longer than the minimum size would decline, especially in sections of river with the most fishing. Anglers on the upper St. Joe River presently catch feti cutthroat one inch longer than the 13-inch minimum size limit.

St. Joe River

Trophy-fish angling regulations protected cutthroat trout in the upper St. Joe River from angler harvest and allowed the cutthroat population to increase in abundance. Anglers fishing the upp--.• St. Joe River in 1975 were mostly in favor of the trophy-fish program and anglers fished about the same number of hours in the special regulations area in 1975 as they did before initiation of trophy-fish regulations. To document the full effect of the 13-inch minimm size limit on abundance and age structure of the cutthroat trout population, present trophy-fish regulations would have to be continued _until the spawning of the offspring of the first cutthroat "saved" by trophy-fish regulations occurs, and their offspring are recruited to the population and fishery. Age III cutthroat were probably the most abundant age group in the upper St. Joe River in 1971 (Table 43). Most of these fish matured at age V (Table 40) and spawned in 1973, and their offspring would spawn in 1978 (Fig. 21). The effect of the 13-inch minimum size limit on the cutthroat population will be more fully evident in 1980 and 1981 when ge II and age III fish of the 1978 year class enter the river and are counted in the snorkeling transects.

Other management options for the St. Joe River fishery could be considered. A smaller minimum size limit might be considered to allow a larger harvest of cutthroat by anglers since some cutthroat trout in the St. Joe River may spawn and die before reaching the 13-inch minimum length. Most cutthroat trout in the St. Joe River reach the minimum size of 13 inches during their seventh summer of life (age VI) (Table 27). The mortality rate between ages V and VI was 0.92 in 1975 (Table 44), indicating that a large

^~ ,“rthroat :rout were lost either to natural mortality or illegal

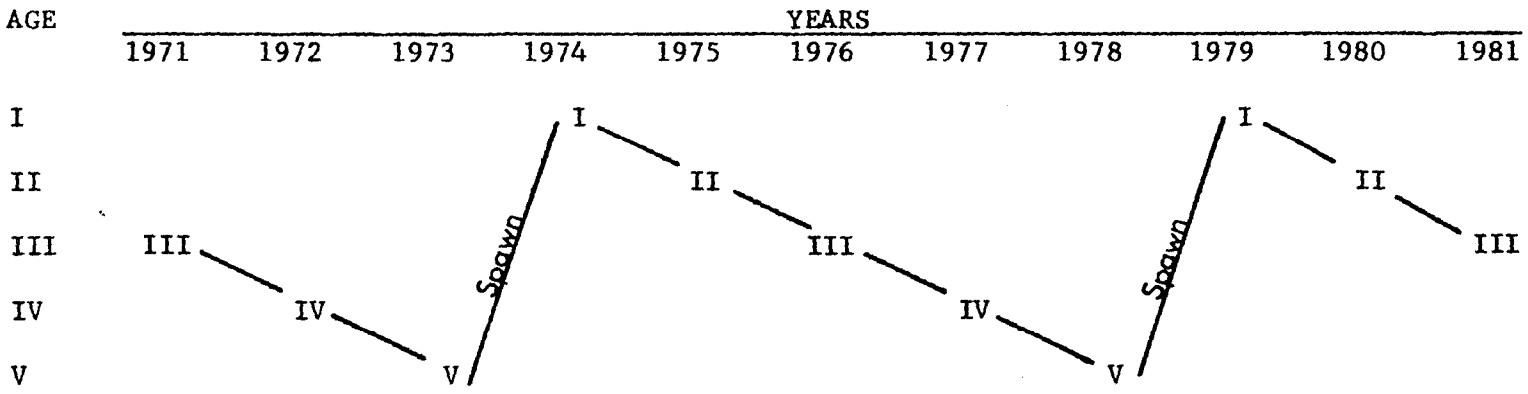


Figure 21. Age III cutthroat trout "saved" by the trophy-fish regulations starting in 1971 probably spawned at age V in 1973, and their offspring would spawn in 1978. The effect of the 13-inch minimum size limit on the cutthroat population in the upper St. Joe River will be more fully evident in 1980 and 1981 when age II and age III fish of the 1978 year class enter the river and are counted in the snorkeling transects.

harvest by anglers. In 1975, only 2370 of the age V cutthroat caught by project personnel during the summer were longer than 13 inches, thus few age V fish should have been harvested even allowing for the harvest of sub-legal fish. A minimum size limit which would allow anglers to harvest smaller cutthroat from the upper St. Joe River may reduce the number of trout lost to natural mortality.

I believe that initiation before 1980 or 1981 of a reduced minimum size limit which protected cutthroat spawning for the first time would not endanger the cutthroat population. In most years, cutthroat surviving to the and of the summer would spawn the following spring before being subjected to the fishery in the upper St. Joe River. Unless harvest of cutthroat from the lower St. Joe River increases **appreciably,** this fishery will not adversely affect the cutthroat population in the upper St. Joe River.

Since most female cutthroat trout in the upper St. Joe River spawn first at age V (Table 40), cutthroat should be protected through their fifth summer of life (age IV). Minimum size limits of 11 and 12 inches would protect many cutthroat spawning for the first time at age V since age V cutthroat averaged 11.3 inches (287 mm) at the time of annulus formation in the spring (Table 27). **In** 1975, of 81 age IV cutthroat collected and measured by project personnel during the summer, 13 (16.0%) were longer than 11 inches and 6 (7.4%) were longer than 12 inches. None of the 254 age III cutthroat collected by project personnel were longer than 11 inches.

A better estimate of the effects of 11- and 12-inch minimum size limits on the number of cutthroat surviving to first spawning is the proportion of cutthroat longer than each size limit at the end of their fifth grow-

--^--~~f-oo r.,n.,7,4 *orrn„nt Fnr orr,..,ti, of r:,tthrnat*

during the entire fishing season, and include all cutthroat which would reach the minimum size by the end of the season. For 81 age IV cutthroat, 44 (54.3%) would be longer than 11 inches and 4 (4.9%) longer than 12 inches at the end of their fifth growing season (age IV). Of 254 age III cutthroat, 9 (3.5%) would be longer than 11 inches and none longer than 12 inches at the end of their fourth growing season (age III). We inspected seven age IV and one age III female cutthroat that would have been longer than 11 inches at the end of the 1975 summer. All of these females were mature and would have spawned the next spring. Sixteen percent of the age IV cutthroat had probably already spawned once (Table 54).

Table 54. Total lengths at maturity of age III and age IV female cutthroat trout collected from the upper St. Joe River in 1969, 1970, and 1975. Total lengths are projected lengths in September for cutthroat collected in July and August.

Age class	Total length (mm)	Number inspected	Number mature	Percen mature
III	217-280	25	4	16
	281+	1	1	100
IV	219-250	8	2	25
	251-280	18	10	56
	281+	7	7	100

If anglers caught all of the age III and age IV cutthroat which grew to lengths longer than 11 inches during the summer, about half of the cutthroat would be harvested before spawning at least once. This harvest may reduce the abundance of spawners below the number required to maintain the population at full abundance of age III and IV fish.

If anglers caught all of the age III and age IV cutthroat which grew to lengths longer than 12 inches during the summer, only about 5% of the cutthroat would be harvested before spawning at least once. Setting the size limit at 12 inches would allow harvest of some cutthroat between 11 and 12 inches in length and still protect an adequate number of spawners.

The setting of a size limit can be delicate in situations where most spawners are needed to maintain an abundant population. By lowering the size limit from 13 to Linches, an additional 3.67. of the 1975 population would be legal-sized during the summer (Table 21), but only about 5% of the cutthroat would reach the minimum size by the end of the fishing season and be available for harvest before spawning at least once. By lowering the size limit from 13 to 11 inches, an additional 8.6% of the 1975 population would be a legal size during :ha summer (Table 21), but about half of the cutthroat would reach the minimum size by the end of the fishing season and be available for harvest before spawning the first time.

Initiation of a s l i e r minimum size limit would have several effects on the cutthroat trout :---.:ration and fishery in the upper St. Joe River. First, angler satisfact_ n would probably be increased since a larger proportion of the cutthroat p.-.7-ration would be of a legal size. Numerous anglers interviewed in 1975 com_:ed that it was "a shame" to have to release cutthroat between 12 and 1: inches in length. Second, the reputation of the upper St. Joe River as `_:·:d" fishing for native cutthroat trout may induce more anglers to fish the _per St. Joe River, especially if the minimum size limit was lowered. Third, abundance of cutthroat longer than the new minimum size would decrease, espe:telly in sections with the most fishing.

Each proposed application of special angling regulations must be carefully scrutinized on its own merits, taking into account both its biologics: and social implications (Hunt 1970). A survey of angler attitudes should be an integral part of any management plan (Gordon at al. 1970). Resource agency employees should also be treated as participants, be actively informed, and be thoroughly involved in the development of both the basic proposals and the public information process (Chaplin 1971). The angling public should be informed of management alternatives and their trade-offs. The management alternative would ultimately be selected by fishery managers and/or the Fish and Game Commission.

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